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ENGINEERING AND
MINING JOURNAL

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

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By E. R. Polley

Mine Engineering Methods in Peru

By J. C. Pratt

Utah Copper's New Precipitating Plant

By H. D. Keiser

In the Bisbee-Warren District of Arizona

By E. H. Robie

The Salt Lake Mills and Smelters from the Air

Complete Quotations for Metals and Non-Metallic Minerals

New Shaft Sinking Record on the Rand

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The 286 feet sunk in March of this year broke the old record of 270 feet which had stood for 8 years. The shaft is 31 ft. x 13 ft. and has 5 compartments.

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Type of Shaft	Vertical
Dimensions	31'x13'
Work Included	Timber and Guides
Working Days (3 shifts)	31
Number of Machines	7
Holes per Round	72 to 84
Footage advanced per day (24 Hr.)	9.26'
Type of Machine	N-72 with Sinker Handle

The monthly progress in sinking, timbering the shaft, etc., in the four-month period from March 1st to July 1st, was as follows:

March	286'
April	279'
May	300'
June	282'
Total	1147'
Average per month	287'

R-1731

(332-JD)

Ingersoll-Rand

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The Phelps Dodge Issue

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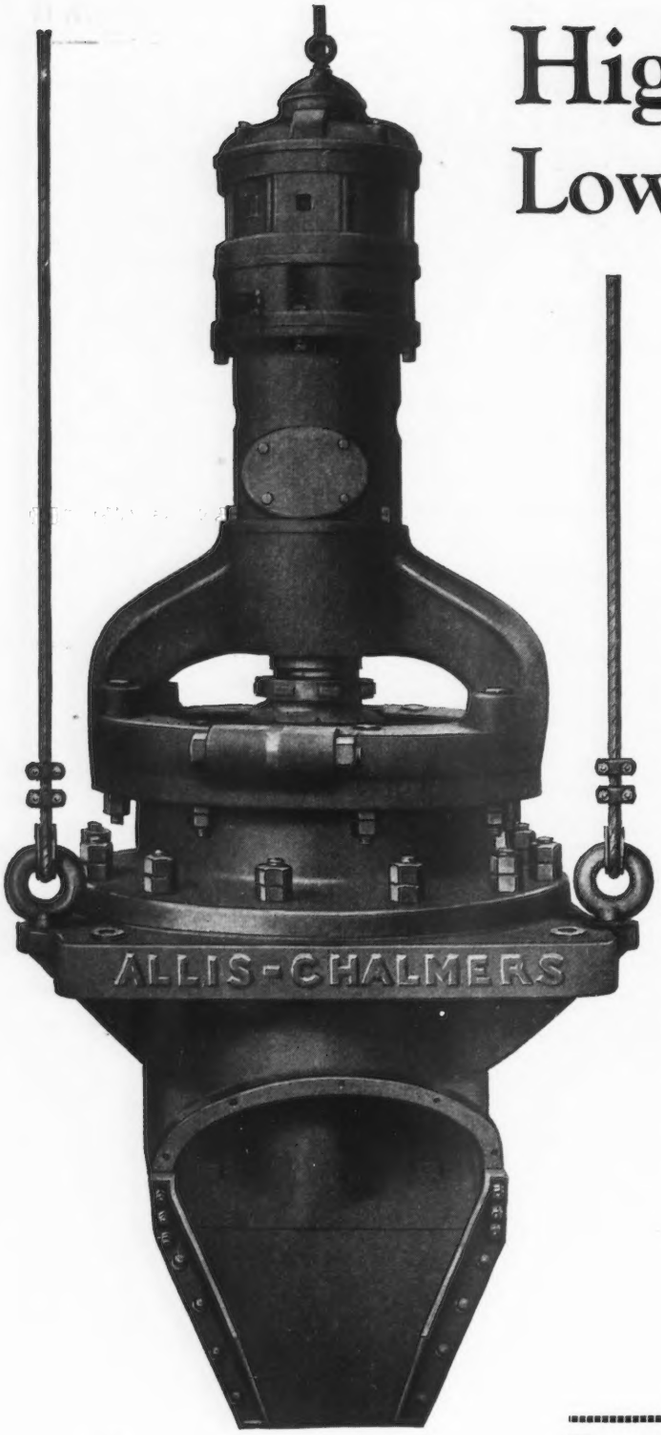

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MILWAUKEE, WIS. U. S. A.

ENGINEERING AND
MINING JOURNAL

McGraw-Hill Publishing Company, Inc.
JAMES H. MCGRAW, *President*

A. W. ALLEN,
Editor

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Industrial Statesmanship and Employee Responsibility

IN MAINTAINING that work should provide happiness for the worker, Dr. Glenn Frank, president of the University of Wisconsin, recently said that "Humanity is hag-ridden by the ancient tradition that work is a curse. . . . We turn to toil as to the serving of a sentence. We look for happiness behind the barricaded walls of pleasure. . . . Happiness cannot be switched on, like an electric current, after office hours. If we cannot somehow manage to find satisfaction in our work, there is small chance that we shall find it outside our work. Men's work must be made a means of self-expression as well as a means of self-support. We must see that it provides, first, difficulty enough to give us a sense of adventure while we are doing it and a sense of mastery when it is done; we are happiest when we find in our work a moral equivalent for that mood of adventure and thirst for conquest that we have dragged along with us from our days of savagery. Second, we need routine and variety mixed in the right proportions; routine is not the enemy of happiness that it is sometimes painted to be; the amount of routine in our work must be adjusted to the amount of creative ingenuity we possess. Third, we need a sense that we are creating something we can see and claim as our personal accomplishment. Fourth, we need congenial associates."

So eminently sane and healthful a philosophy is refreshing in these days of mud slinging and bickering over non-essential political differences. To supplement Dr. Frank's recommendations it is only necessary to repeat that much daily routine is inevitably composed of work that is disliked, with a leavening modicum of work that is welcome because, perhaps, it can be done well or easily. The secret of success lies in the power to dispose of the uncongenial task in the quickest possible time; thus it is that the wise man will tackle the hardest problem first. He realizes the moral effect of having overcome obstacles. After a while his uncongenial tasks become less formidable; they take less time and involve less labor. He systematizes his actions to such an extent that a new element of interest is introduced.

It has been said that work is the foundation of our civilization—that wisdom is no more, culture no more. To a distinguished dramatist, Mr. David Belasco, is credited the saying that "The curse of our time is the vast army of people who care nothing for their work." He believes that we were made to work, that we should love our work, "find real and profound pleasure in it; and so labor on until, tired out, we might sleep like little children at the end of each day."

The distinguishing feature of American engineers and technicians is the interest they take in their work, even in the so-called leisure time. For the benefit of those at the bottom of the ladder an element of attraction can be introduced that will do much to hasten the transition of laborer to artisan, to mechanic, or to technologist. To find happiness in one's work is to find success also.

Abnormal Business Risk Not Inherent to All Mining Investments

THE consultant whose replies to correspondents appear under the caption "The Inquiring Investor" in the *Wall Street Journal* recently gave the advice that "you do not have *an investment* [the italics are his] in Kennecott shares around the present price of $98 to $99." He is apparently of a more conservative turn of mind than the writer for the same publication who nonchalantly placed the annual profits of Andes Copper at $16,875,000, on the basis that it would be producing 225,000,000 pounds "at a cost, including depreciation and taxes, of 7½c. per pound." The selling price was assumed at fifteen cents. That, however, is beside the point.

The commentator on Kennecott ventures the opinion that the company, at current prices for copper, is earning about $9 per share. He properly points out that, in spite of the promising outlook for the metal, declines in the market price are probable, and that these, of course, would have an adverse effect on income and profit. On the other hand, it may be emphasized that in judging the value of the security as an investment, the average price of the product over a long period of years must be considered. Most students of the copper market agree that, on the long pull, the price tendency will in all probability be upward. Moreover, it is almost certain that demand for the metal will increase within a few years to such an extent that Kennecott will feel warranted, through its Utah and Braden properties and its 45 per cent equity in Nevada Consolidated, in increasing production by 120,000,000 pounds annually. This can be done without any considerable capital expenditure; and further output increases could be made, without straining mine capacity, by adding equipment. It seems fair to assume that Kennecott over the next thirty years ought to earn not less than $10 per share after taxes and depreciation. But suppose that $9 per share were paid in dividends; how good an investment would Kennecott be today at $100 per share?

The writer in the *Wall Street Journal* argues that "one must get a return of from 10 to 11 per cent at the very least to make a mining investment"; and on that

basis he decides that Kennecott is not so "wonderful." One is inclined to believe that he is overlooking factors that differentiate Kennecott from many other mines. He speaks of a mining property as a wasting asset. The significance of this is that the orebody—the underlying asset—finally is exhausted, so that, in addition to interest on capital invested, the principal itself must be returned. But, from an actuarial standpoint, this factor is negligible if the life of the property—the period of dividends at the assumed rate—is upward of thirty years. The Kennecott annual reports for 1927 show that, even after rates of production of all the properties are increased substantially, the proved reserves, excluding the relatively unimportant Alaskan mines, are sufficient for more than thirty years.

To obtain his figure of 10 or 11 per cent minimum return, our friend adds to 3 per cent—which he says is necessary to return the capital investment in 23½ years—"at least 7 or 8 per cent for the risk taken." In the operation of mines like those of the Kennecott group—again excluding those in Alaska—the element of risk is no greater than in most other kinds of industry. The supply of raw material can be measured and analyzed accurately. It is possible to estimate the cost of manufacture, which varies mainly with the general level of commodity prices and wages—fluctuating factors, to which all other industries are subject. However, the risk peculiar to mining in general is the uncertainty regarding the extent and grade of the orebodies. This is absent in the case of the Kennecott enterprise, just as it is in respect to various other similar deposits. There remain possible variations in the market price of copper and consequent fluctuations in the margin of profit on each unit produced. But all industries—textiles, general manufacturing, merchandising, railroads, construction, and meat packing—have their ups and downs, their lean periods and their fat ones. If 7 per cent be considered sufficient return to classify an investment in a general industrial company as "good," Kennecott at 9 per cent comes close to being "excellent."

The Safety Factor and Shrinkage Stoping Methods

A CORRESPONDENT in a recent issue of *E. & M. J.* classes shrinkage stoping as the least safe of the ordinary methods of mining, a statement that should bring a reply from some of the numerous mine operators who have enviable accident records, even though the ore in their mines is extracted by this system. It is, of course, true that, in some kinds of ground, shrinkage stoping would be decidedly unsafe, perhaps the most unsafe of any method, and this is probably what our correspondent means. It is also true that at some mines where shrinkage stoping has been practiced—one in Arizona comes to mind—the accident record has been bad, but this is attributable in part to carelessness and in part to the lack of a proper understanding of the best manner of applying shrinkage to the rather soft ground.

If mining be conducted so that the back will be properly arched, with pillars rightly spaced, if care be shown in barring down, and if a little timbering be set to support any weak places, perfectly safe mining may be conducted by this method in ground that is adapted to its use. In exceedingly favorable ground, wide stopes and comparatively narrow pillars may be safely used; the upper levels of the Creighton mine, in Ontario, for example, have 60-ft. stopes and 15-ft. pillars. In softer ground or at deeper levels the stopes should be narrower, and shrinkage is often combined with caving. The statement is true that emergency timbering cannot be used without stopping the drawing from chutes below; but, where it is necessary to set timbers on broken ore, ore passes may be carried up at various points along the working, leaving a considerable body of broken ore sufficiently stable to act as a support for timbering while it is required.

In brief, shrinkage stoping can be abused. It requires, for its successful application, ground that stands well, but the mines that use this method intelligently have as satisfactory safety records as those that employ other mining systems. Letters from operators who are proud of their safety records, with an explanation of the means used to reduce accidents, will be welcome.

Fighting Without Prior Thinking Invites Defeat

THE recent surface fire at the Kennedy mine, near Jackson, California, draws attention to the hazard involved in a state of unpreparedness for such an eventuality. The point sometimes overlooked is that a surface fire may endanger the lives of men working underground. In this respect, however, the provisions made at the Kennedy mine were adequate: No loss of life occurred. Escape of all the men through the duplicate emergency exits was satisfactorily accomplished in a minimum of time. The air currents provided by a mechanical ventilation system could be and were promptly reversed, thereby preventing a flow of the gaseous products of combustion into the underground workings. The provision of an efficient telephone service enabled a warning to be sent below, and thereby aided in the prevention of a more serious disaster.

On the other hand, the Kennedy fire, if the lesson be taken to heart, should provide a general warning to some other mining companies, more particularly in regard to surface conditions. In this instance, the buildings had been erected close together and without intervening fire walls, and a large amount of combustible material was stored near the shaft. A line of buildings to the north was intersected by a roadway, but the fire swept across the space. The presence of large amounts of dry timber in the vicinity of the buildings and shaft served to feed the flames of what otherwise might have been a minor conflagration, with the result that the fire was soon out of control. The incident, happily without personal injury or loss, was apparently necessary to focus attention on a contributary cause of fire and to prompt inquiry as to how the hazard may be avoided.

A prominent educationalist recently said that life is mostly conflict, but that fighting without prior thinking invites defeat. This is particularly true in regard to the fire hazard. Successfully to fight the elements involves

much prior thought on how they may be made our servants instead of our masters. Complete prevention of disaster may be aimed at, but the goal is seldom achieved. The possible antecedents to the loss and disorganization inseparable from fire hazard, not only as to the birth of a conflagration but in regard to its spread, must be made the object of intensive study, to the end that factors contributing to a condition commonly designated as "out of control" may be avoided.

Tin Industry Boosted by Agricultural Expert

ONE cannot blame a state official for trying to boost industrial enterprise in his own field of activity, but the exuberance displayed is sometimes amusing, and therefore of questionable authority. No more frothy propaganda has reached *Engineering and Mining Journal* in months than the effusions of Mr. Louis N. Crill, Secretary of Agriculture for South Dakota, from which one gathers that the natural resources of the state are vast and almost undeveloped; the packing and canning industries, vegetable growing, sugar manufacture, muskrat farming, hydroelectric development, and the utilization of wheat-straw and cornstalk wastes—these have each been the subject of special mimeographed bulletins. So long as Mr. Crill sticks to the agricultural industries, a mere engineer may generously allow him free play for his imagination, but mining seems to be his adopted province as well.

Consider, for instance, a bulletin on tin for which Mr. Crill is sponsor. To appear authoritative, it is headed "An Associated Press Article," but that eminent news-gathering agency disclaims all responsibility for its dissemination. We quote extracts at random from the bulletin:

"The largest tin mill in the world is located at Tinton, Lawrence County, South Dakota." [Its capacity is 300 tons of ore per day.] "It will be running in full force by July first and will steadily employ 80 men." [We have it on the authority of the manager that it had not started on Sept. 14.] "We have tin deposits equal to those found anywhere in the world." [Mr. Crill seems to be the only authority for this statement.] "The tin ore, which will average, it is thought, about 2 per cent concentrates, is worth $800 per ton." [Tin metal itself is worth only $950 a ton, and we fancy that there is more than $150 spread between the ore in South Dakota and the metal in New York.]

"While the milling and grinding and shipping of tin concentrate will be a profitable industry for the state," the account continues, "and one of great importance, the next thing to accomplish is the smelting of the tin concentrates in South Dakota, and from the tin bricks the manufacture of all kinds of tin plate and articles that are demanded commercially." This information, if authentic, would cause our British friends still further anguish; for if the facts be as stated the days of the shipment of "tin bricks" to the United States are numbered, even though the gold-brick industry still flourishes. And finally we read that "The old hobby that everything has to be made down east or in England will and must be discarded."

Aluminum, too, is waiting to be developed, and one might infer from the account that the Aluminum Company of America has, for once, been asleep so far as the South Dakota deposits are concerned. Speaking of the Missouri River, which is compared with and to the disadvantage of the Nile, the Rhine, the Hudson, the Ohio, and the Mississippi, Mr. Crill says: "Along its banks in South Dakota 25 per cent of the shale is pure aluminum, when separated from the elements." And in addition to tin and aluminum there is mica, tantalum, zinc, lead, copper, and sericite. The vein of tantalum is "the only known deposit in paying quantities anywhere in the world," and "the value of tantalum concentrate, f.o.b. cars at the Lawrence County station, is $2,200 per ton." Also, the sericite "is the only deposit in paying quantities known anywhere."

The National Tin Corporation is still at work at its properties at Hill City, S. D., the possibilities being sufficient to attract capital from time to time. The tin occurrences at Nigger Hill, which are the subject of Mr. Crill's optimistic outburst, have had less attention, but are now being developed by the Black Hills Tin Company, of which Mr. John Bland has been manager, Mr. John Beatty having recently taken over the financial management. Those in control of this company state that exploratory and sampling work lead them to believe that the operation will be successful, but that they desire no publicity until the mill is operating, and operating successfully. We suggest to Mr. Crill that, with advantage to his reputation, he may accede to their wishes.

No one can say yet whether or not a new tin producer is budding in South Dakota. Continued search for the metal in the United States is worthy of support, and no one will congratulate the first successful producer on a large scale more heartily than will *Engineering and Mining Journal*. Until commercial production is reached, and until definite and trustworthy information is available, however, an exaggerated and over-optimistic report from a state official may do considerably more harm than good.

Solubility of Gangue Material in Cyanide Solution

ATTENTION has been drawn at intervals to the ambiguity of the customary statement as to the insoluble portions of an ore. Insoluble in what? is the question usually asked. In this connection it is regrettable that no discussion followed the paper describing the researches of Mr. C. J. Brooks, presented to the Institution of Mining and Metallurgy some years ago. Trouble was experienced in zinc-box precipitation, and an investigation was undertaken. The ground ore was found to be soluble in water to the extent of nearly one-tenth of one per cent—a large amount when mill tonnages are taken into consideration. An examination of the zinc-box precipitate showed nearly one per cent of sulphur and neary one-half of one per cent of silica. It was definitely proved that silica was precipitated along with the gold and silver, but no conclusion was reached as to the precise reactions occurring. The results of this research are on record in Volume XXXVI of the *Transactions* of the Institution. A greater interest in this subject would have been justified, and it is hoped that metallurgist and chemist will reopen the subject with constructive comment.

Utah Metallurgical Plants

Above—Tooele plant of the International Smelting Company, where both lead and copper ores are smelted. Right—Utah Copper's Magna concentrator. The links in the white "chain" in the foreground are 75-ton ore cars.

Right—Murray plant of the American Smelting & Refining Company, one of the largest lead smelters in the world.

Left—Utah Copper's Arthur concentrator, adjacent to the Magna plant on Great Salt Lake. The two together can grind and float 40,000 tons of ore per day.

Right — Garfield copper smelter of the A. S. & R. Co. Utah Copper concentrates, together with miscellaneous custom ores, are handled here.

Mine Engineering Methods

At Cerro de Pasco's Casapalca Mine

By J. C. PRATT

Chief Engineer, Cerro de Pasco Copper Corporation

THE mine surveying party at the properties of the Cerro de Pasco Copper Corporation, at Casapalca, Peru, consists of an engineer and three Peruvian helpers. The chief helper is an experienced man, familiar with the routine of surveying, able to take the necessary care of instruments, and equipment. A Berger wet-mine transit is used for mine surveys. It is supplied with a short-focus lens and an auxiliary telescope.

Sixty-meter steel tapes graduated to the nearest half centimeter are employed. Such a tape, which requires interpolation only between 5 mm., is preferable because it gives more accurate results and requires less time to read. Every effort is made to keep the tape off the ground when measuring, whether underground or on surface. It is, of course, cleaned every day that it has been used, but the helpers are inclined to be over-industrious in this, with the result that the embossed graduations are gradually worn down in spite of repeated warnings.

The plumb bobs are of nickel-plated steel filled with mercury. These have the disadvantage that the point rusts after having been reground, and the nickel is thus removed; but they are otherwise convenient because of their high specific gravity. Bronze spads are used entirely underground, even though the mine water is only slightly acid.

Surveys of all workings are brought up to date at the end of each month, at which time the helpers go into the mine in advance and put in the required stations in drifts and crosscuts. Everything is thus ready for the engineer to do the surveying with a minimum of delay.

LEVELING WITH TELESCOPE BUBBLE

The routine for transit work underground is as follows: Set up under the station, level with plate bubbles, and then with telescope bubble. With the instrument thus leveled, set the horizontal vernier on zero, back sight with telescope inverted, turn angle to the right, read, and record. Plunge now to erect the telescope, back sight, turn the horizontal angle again to the right, read and record doubled angle. Immediately multiply the single angle by two as a check on the double. Now set the vertical vernier on zero and sight the plumb line on the foresight. The helper holds his light behind the line, moving it up or down until on the horizontal with the instrument. This gives him the point on the plumb line at which he should hold the tape. The zero end of the tape is held at the foresight by the chief helper while the engineer measures the distance to the acorn nut on the horizontal axis of the instrument. After the distance is taped two or more times, until checked, move on to the next set-up.

In continuing a survey from the previous month the transit is set up under the last old station—that is, the one on which the last previous foresight was taken. The first back sight is always taped and recorded in order to be certain of the stations used, regardless of the numbers that may be painted on the walls, which often are misleading. The use of small brass tags bearing the station number was tried some time ago, but

CARD N.° 1 WORKING Shaft LEVEL 1700-1860 MINE Carlos Fco.

DATE	B. S.	STA.	F. S.	HOR. ANGLE SINGLE	HOR. ANGLE DOUBLE	Meas. Dist.		Vert. Angle	REMARKS
1/24/28	14	18	23	182-13	4-27				
J.P.					182-13½	17	932	-0-	
	18	23	24	173-10	346-20				
					173-10	5	513	-0-	
	23	24	25	87-37	173-36			-0-	Side Tel.
		HI +3.022	HP +720		86-48	32	880	70-34	
	24	25	26	184-58	10-12				Side Tel.
	HP -2.665	HI +2.711	HP -1.346		185-06	16	970	71-15	

Fig. 1—Typical page of transit notes

it was found that the miners often stole these, pulling the spad out in the process and thus destroying the station.

It will be noted that the telescope was erected for the last sight, so that when the vertical vernier was set on zero for taping the distance the instrument was ready to set up under the next station without moving either circle.

The horizontal vernier is set on zero for each set-up, but not until everything is ready for turning the angles, which insures against error in accidentally moving the tangent screw while carrying the transit or leveling up.

Few engineers use the telescope bubble in leveling a transit, yet it is rapid and has the advantage of accuracy. Plate bubbles seldom stay in adjustment, and are strongly affected by changes in temperature, whereas the telescope bubble does not have to be in adjustment for leveling the instrument (peg adjustment). In using the latter the telescope is first lined over opposite leveling screws and the bubble brought to center by the tangent screw of the vertical circle. The instrument is then swung 180 deg. in azimuth and the bubble allowed to come to rest. Half its run is taken up with the leveling screws. Repeating the procedure over the other pair of screws completes the operation.

After all the points of a given working have been surveyed, the plumb lines are again put up, starting at the last old station, and the tape is stretched from point to point, while widths, or off-sets, are taken to left and right at two-meter intervals.

The field notes for transit work, designed specially for

mine surveying, are shown, together with sample entries, in Fig. 1. The back-sight distance, if any, is placed on the first line; the foresight on the second. In the office, the correct single horizontal angle is written in ink under the doubled angle—that is, right next to the foresight distance. Vertical angles are recorded next to the corresponding distances. Height of instrument and of point are recorded under the station numbers. The reverse side of the card is ruled for recording widths. These are entered in decimeters; for example, 6 = 0.6 meters.

Wye Level Used for Elevations

In leveling work all elevations, both underground and on surface, are carried with wye level. In the mines, the elevations of the bottom of the wooden plug of each station (not the spad, which may be and often is knocked out), and that of the rail below the station, are taken.

Fig. 2 shows the form for level notes; these are the same on both sides of the card. It will be seen that the H.I. (height of instrument) is set down one line from the B.S. (back sight) from which it is derived. By doing this, the H.I. lies opposite the first F.S. (foresight) for which it is used. This is an advantage when there are several F.S.'s for each H.I., as in profile work; uniformity demands that this notation be used at all times, whether the foresights are one or several.

Since the rod is held inverted when taking the elevations of stations, the signs of F.S. and B.S. must be changed; these should be marked to prevent oversight in figuring elevations later.

A two-mile tunnel is being driven in Casapalca at present, on line and grade. Grade is checked once a week; line points are put in every other week. The spads are lined in the back sighting and plunging to line, turning in azimuth to the back sight, and plunging again.

Elevation of the track is taken at each station as soon as established, and on alternate weeks as far ahead as possible. Grade stakes are driven one foot above the correct elevation of the track.

The workings in Casapalca are on narrow veins. Raises are run up on the vein from one level to another. If the vein is "lost," a hanging compass will usually solve

CARD N.° 3A WORKING 14MN LEVEL 1400 MINE CARLOS Fco.

DATE	POINT	B. S.	H. I.		F. S.	ELEV.		REMARKS
10/11/27	Δ21	-0.591				4214	197	
9	±Δ22		4213	606	1.482	4212	124	
	±Δ23				1.439	4212	167	
	Δ23	0.873			+0.942	4214	548	
	Δ24		4213	675	+0.891	4214	566	

Fig. 2—Typical level notes

the problem, so that it is necessary to do relatively little raise surveying with a transit.

Vertical shafts are plumbed by the usual methods. It is necessary at times, however, to carry a survey from one level to another either through a raise or an inclined shaft. In such work a side telescope is employed exclusively in preference to a top. Let us see what are the advantages in the use of the former. With it, the instrument can be inverted, or plunged; not so with the top telescope. The latter gives the correct single angle, it is true, but since all angles are doubled, this is no advantage, inasmuch as the side telescope gives the correct doubled angle, which may be reduced. Moreover, there is no extra work in the office in calculating the distances when using a side telescope, which is not the condition with the top.

Even in carrying a straight line out of or into an inclined working, the side telescope may be used to advantage by setting two points, obtained by back sighting and plunging with the instrument both erect and inverted, and then putting the line point halfway between

CARD N.° 1A LEVEL 1600 (TRANSIT STATIONS) MINE CARLOS Fco.

STATION	WORKING	CO-ORD.	FIELD NOTES	RECORD SHEET	REMARKS
1	16M40N	400	Cd.1	1	
2	"	"	"	"	
3	"	500	"	"	
4	16M60S	600	Cd.1	"	
5	16M40N	500	Cd.1	"	
6	"	"	"	"	
7	"	"	"	"	
8	16M30W	300	Cd.1	2	
9	"	"	"	"	
10	16M60S	600	Cd.1	1	
			"		

Fig. 3—Systematizing station numbers

these points by measurement. This is, in fact, more accurate than turning the instrument 180 deg. as read on the vernier, which is the only procedure with the top telescope.

For sighting the plumb lines in any kind of work, use is made of a piece of tracing cloth held in a small wooden frame, 4x6 in. For inclined sights in which elevations are carried by transit, a piece of string is tied on the plumb line and the sight taken on the knot, which may be moved up or down to a convenient position; a button may be employed as an alternative.

Stopes are either shrinkage or cut-and-fill; of the two, the former predominate. All stopes are measured twice a month with clinometer and tape. The shrinkage stopes are plotted on special sections, scale 1:250, for the purpose of tonnage calculations, including "tons broken" and "tons remaining in stope." These stope profiles are transferred to standard, longitudinal-section sheets, scale 1:500, which will be discussed later.

Numbering of Transit Stations

Each engineer who surveyed on a given level during the course of many years adopted his own system of numbering stations. He disregarded that of his predecessors, and his own system was ignored by his successor. The result was a collection of numbers and letters, and combinations thereof, that made it impossible for anyone to select a series and be sure it had not already been used.

To reduce the station numbering to a system, the cards shown in Fig. 3 were introduced. They are the same as those used by the Arizona Copper Company, from which they were copied. When it came to recording the station numbers it was found that the same numbers, especially from 1 to 50, often occurred anywhere from two to four times on a given level.

The custom now is to use the simplest number possible; that is, to continue numbering from 1 upward, using up all the blanks on the way. For example it happens that on many levels either only the old or only the even numbers had been used. New stations are given the open numbers in the series, as long as it lasts, after which numbering is continued consecutively.

If more than one working is being driven on a given

Mine CARLOS Fco
Level 1700
Working SHAFT
Sta. Rec. Surveyed V.P. Calculated V.P. Checked G.M.

COMPUTATIONS

File SHAFTS-1700
Field Notes Cd. 1.
Rec. Sheet 1.
Rec. & Checked G.M.

Date	B. S.	Sta.	F. S.	M. D. V. A.	Cos. Sin.	Hor. Angle	Hor. Distance Bearing	Cos. Sin.	LAT.	DEP	Elevation	Long. Sect.	Sta.
1/29/8	14	18	23				17.932	.85762	+15.379	+9.222			
S						182-13½	N30-57E	.51429	10,491.613	12882.161			23
	18	23	24				5.513	.91272	+ 5.032	+ 2.253			
						173-10	N24-07E	.40860	10,496,645	12,884,414	4200.043		24
	23	24	25	32.880	33271		10.940	35701	+ 3.906	−10 219	-31.007		
		+3.022	-0.720	70-34	94303	86-48	N69-05W	93410	10,500.551	12,874,195	4171,338		25
	24	25	26	16.990	32144		5.455	43863	+ 2.393	− 4.902	-16.069		
		+2.711	-1.345	71-15	94693	185-06	N63-59W	89867	10,502.944	12,869.293	4156,635		26

Fig. 4—Calculation of latitude, departure, and elevation from field notes

level, it is the practice to number the stations as they are put in, irrespective of location.

For accurate work on the surface, stakes are driven into the ground for each station, and a small finishing nail is used for the point. All distances are taped from the axis of the transit to the nail, either back sight or foresight, and the vertical angle is read both erect and inverted, taking the mean as correct. Horizontal angles are always doubled.

By doubling the horizontal angle and taping both ways, one has in the end a survey the accuracy of which cannot be questioned. Taping one way only, and turning the angle only once, no one can be sure that there are not one or more large errors, such as come from misreading the tape by a meter, or an angle by 10 deg. A tangent screw may be moved, an angle may be incorrectly read; frequently the result is a surveyor out of a job.

Recording Notes in Office

The cards used for calculating surveys are shown in Fig. 4. They are 8½x11 in. The ease of carrying the calculations of a continuous survey will be seen readily. This card may be used both for traverse tables and for "naturals" and a calculating machine. The latter is the method employed almost exclusively here. With the traverse tables the sine and cosine column is left blank of course. The reverse side of the card is blank and is used for bearings and miscellaneous calculations.

The veins of the mines are of a more or less uniform strike; hence the plans are made on mounted paper several feet long and three or four in width. The scale for working maps is 1 : 500. Horizontal co-ordinates are ruled every hundred meters in black ink. The map is a record of all stations, the details of off-sets as taken from the transit cards, the location of raises and shafts on each level, and other data. The outline of all workings and other data for each level are in colored ink—a different color for each level so far as possible.

The narrow veins of quite uniform dip and strike make possible the use of longitudinal sections; that is, section maps on the dip and strike. These are of a standard size and comprise given inclined blocks. The scale is 1 : 500. They are filed on boards in their proper order.

All possible details are plotted on the sections, including profiles of drifts, raises, and stopes. The last named are taken from the 1 : 250-scale sections and show the stope profile at semi-monthly intervals. Cross-sections of tunnels or crosscuts passing through the plane of the section, all survey stations, and, most important, all samples, are plotted on these maps as well. These sections, together with the 1 : 500-scale plans, form the most frequently used maps, containing as they do nearly all information that may be required.

All mine sampling at Casapalca is under the direction of the engineering department. The narrow veins of sulphides and the hard wall rock of silicified sedimentary

Fig. 5—Record of samples and assays

Mine CARLOS Fco
Working Place 18MN

FRACTIONAL GROOVE SAMPLES

File No. 18MN
Card No. 1A

10548-IMP. TORRES AGUIRRE

Date	Location	Sample Number Wall	Sample Number Vein	WALLS Assay Ag	Assay Pb	Assay Zn	Width	Assay-Width Ag	Assay-Width Pb	Assay-Width Zn	VEIN Assay Ag	Assay Pb	Assay Zn	Width	Assay-Width Ag	Assay-Width Pb	Assay-Width Zn	STOPING WIDTH Assay-Width Ag	Assay-Width Pb	Assay-Width Zn	Width	Assay Ag	Assay Pb	Assay Zn	Units	Map Number Sect.	Map Number Plan
7/12/27	Δ74+3.0			1.2	0.8	1.0	1.2	1.44	0.96	1.20	47.3	5.2	9.8	1.3	61.49	6.76	12.74	63.38	8.07	14.59	3.0	21.13	2.69	4.25	34.6		
				0.9	0.7	1.3	0.5	0.45	0.35	0.65																	
	+5.0			1.0	0.5	1.3	1.0	1.00	0.50	1.30	32.4	7.3	8.6	1.0	32.40	7.30	8.60	34.90	8.90	11.80	3.0	11.67	2.97	3.87	25.1		
				1.5	1.1	1.9	1.0	1.50	1.10	1.90																	
	+7.0			3.2	1.1	2.0	1.2	3.84	1.32	2.40	35.0	5.0	8.0	0.8	28.0	4.0	6.4	61.94	9.52	16.10	3.0	20.65	3.17	5.37	37.1		
											30.1	4.2	7.3	1.0	30.1	4.2	7.3											

rocks have made necessary the practice of "fractional" sampling.

Samples are taken at 2-meter intervals in drifts and raises, and at 3-meter intervals in stopes. A given sample is divided into as many portions as there are streaks of vein and wall material. As a typical example, consider a single vein 2 ft. in width. Since all samples are cut on the basis of a 3-ft. stoping width, it is necessary to cut 1 ft. of wall rock. To do this, three samples are taken, one of the vein (2 ft.), and one of 6 in. on each side of it, in the walls.

Where there is more than one vein it must be left to the judgment of the sample boss whether or not all should be taken, with the intervening horse of waste. Ordinarily there are not more than two veins, usually formed by a split, and in most instances the procedure is easily decided on by an inspection.

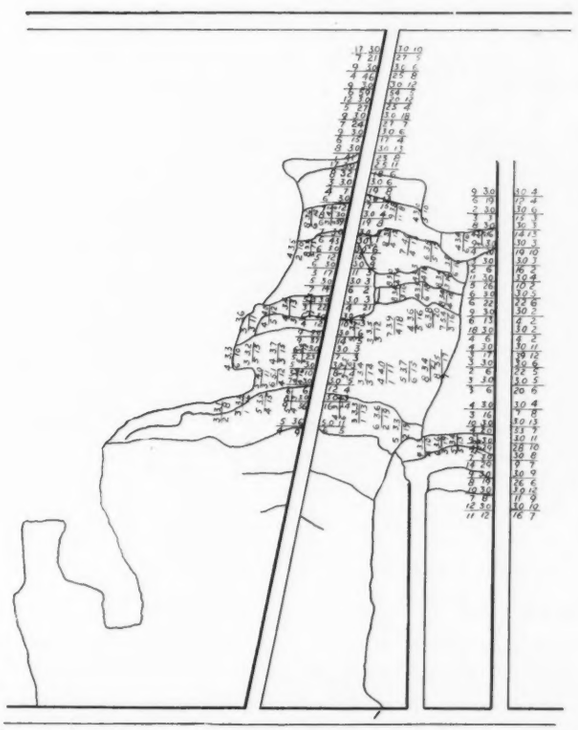


Fig. 6A—Assay map showing metal contents in numbers, Note the difficulty of grasping the significance of the map, because of the confusion of figures.

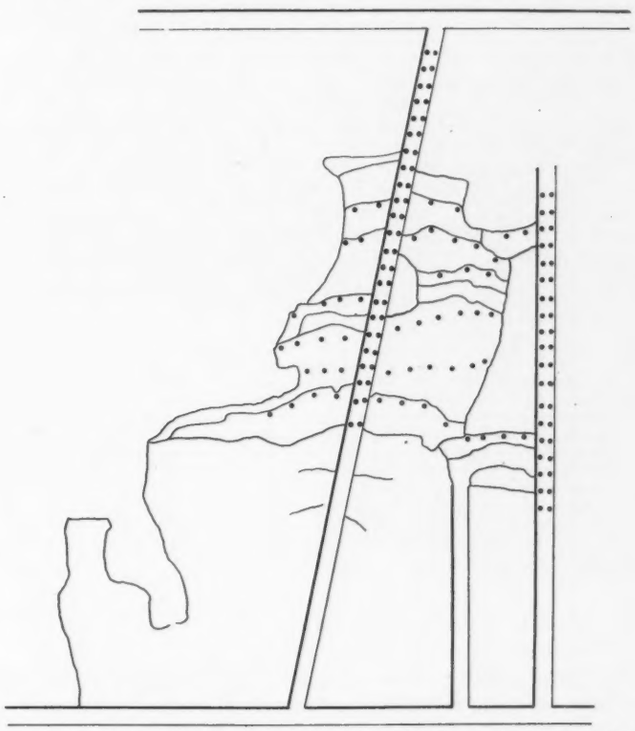


Fig. 6B—The assays shown in Fig. 6A are combined so as to be expressed in one number. The dots are colored according to the grade of the ore sampled

Interpretation of Assays

The usual method of multiplying assay by width is employed. The assays are recorded on 8½x11-in. cards. Having three assays, as on the top line in Fig. 5, we obtain a given assay width for silver, lead, and zinc. This divided by the total width gives the assay of the sample for this width.

We now come to a difficult situation, that of plotting the assays for three metals, plus the width of sample, on sections and plans. Consider the stope shown in Fig. 6A, in which these assays are given figure for figure. The result is hopeless confusion; and much time is wasted in trying to decipher the numbers, which must be kept in mind or checked with a pencil for ore or waste in order to obtain an idea of the tenor.

To make the assays of some value, other than furnishing practice for the draftsman, a system of colored dots was introduced. Leaving out of consideration the involved calculation for arriving at the net values of each metal, we may assume the following hypothetical case, taking no account of what these net values consist of, whether or not they include smelting, milling, freight, taxes:

Let the net values be

Silver = $0.43 per ounce
Lead = 0.98 per cent
Zinc = 0.74 per cent,

which must pay for charges amounting to say $12 per ton. If, now, we assume a more or less constant ratio of metal content of Ag 10, Pb 3, and Zn 5, and give the value of one unit to an ounce of silver, we obtain

1 oz. Ag = 1
1 per cent Pb = 2.28 (98 divided by 43)
1 per cent Zn = 1.72 (74 divided by 43).

Suppose that the ore contains

10 oz. Ag × 1 = 10.00 units,
3 per cent Pb × 2.28 = 8.40 units,
5 per cent Zn × 1.72 = 8.60 units,

Total 29.00 units,

At $0.43 this is equal to $12.47, or just about enough to pay the allotted charges in the example under consideration. We may now divide the grades of ore as calculated in this fashion into four divisions:

1. Very low grade 0 to 20 units (black dots)
2. Almost ore 20 to 30 units (green dots)
3. Low-grade ore 30 to 40 units (red dots)
4. High-grade ore Above 40 units (orange dots)

It will be seen that there is a similarity of color between classes three and four, which are both ore, whereas the two colors for waste, one and two, stand out distinctly from them. Fig. 6B shows the same stope section as

Fig. 6A, using the system of dots (though uncolored) in place of figures.

It may be objected that changes in the metal market, in extraction or recovery, in many other factors, will so change the ratios of one metal to another as to render the maps useless in the course of time. This is true. Nevertheless, during the period for which they are valid the use of dots will save enough time, not only of the draftsman, who would otherwise have to print the assays in full, but also of the persons who must constantly refer to the maps, to make it worth while to draw up complete new maps when changing conditions make the old ones worthless.

The system has worked out excellently at Casapalca; block are figured. These assays are then transferred, after deducting 10 per cent for dilution in shrinkage stoping, to the part of the card containing the area. The average width of ore in the block, multiplied by the area, gives the volume. This, multiplied by three, in turn gives the tonnage of ore, short tons and meters being the units. Tonnage time assays gives total ounces silver and pounds lead and zinc in the block. Thus all relevant information for each block is given on a single line.

It is worth noting that a 10-in. slide-rule divided the same as a 20-in. rule is sufficiently accurate for all the calculations on the card, whereas a 10-in. rule with the usual divisions is not suitable, since it does not give enough places.

MINE Carlos Tio — ORE ESTIMATES — FILE 2100
LEVELS 2100-1900 — BLOCKS 44

Date	Working Place	From	To	Total Ft-Oz Ag	Total Ft-Lb Pb	Total Ft-Lb Zn	Total Width	Total No.	Ave. Ag	Ave. Pb	Ave. Zn	Ave. Width	Sample Cards
1/1/25	21MS	649-02	649+50	970.42	473.64	1521.09	84.7	18	11.5	5.6	18.0	.471'	3A,3B
	⊞S21M39	=2100	=1900	1183.23	785.13	1779.19	131.9	38	9.0	6.0	13.5	.347'	1A,1B
	19MS	641-3.1	645+3	840.02	489.41	1356.64	77.2	18	10.8	6.3	17.5	4.29'	3B,4A
	⊞S19M39	=1900+3	=1900+16	486.82	348.21	762.56	50.0	15	9.7	7.0	15.2	3.34'	1A
	TOTAL			3480.49	2096.39	5419.48	343.8	89	10.14	6.39	15.76	3.865'	

Block No.	Area ×	Width =	Volume × 3.5 =	Tons	Ave. Ag	Ave. Pb	Ave. Zn	Total Ounces Ag	Total Pounds Pb	Total Pounds Zn
44	4590	1.178m	5400	18,900	9.1	5.8	14.2	157,000	1,996,000	4,890,000

Fig. 7—Compilation of sample data to estimate tonnage and grade of ore in a given block

in fact, it is difficult to say in what other form the assays could have been recorded for practical use. A single glance at any stope, drift, or raise will tell what it contains of ore, which is of great assistance, not only in daily use but also in making up the yearly ore estimates.

The work of estimating ore, considering the sampling to be complete and up to date, may be divided into (1) laying out the blocks, (2) adding up the samples, (3) calculating assays and tonnages for each block, and (4) preparing the maps to accompany the estimate. These steps are of necessity tedious, whatever means are employed in doing them, so that any simplification in the process is worth while. The procedure at Casapalca may be briefly summarized in the following paragraphs.

As has been noted, the veins are narrow, so that the longitudinal sections are the only maps that need to be used. These are on tracing cloth. The blocks are laid out on them with a soft pencil, according to the colored dots just mentioned, and their area is obtained with a polar planimeter.

The sample cards for the different workings (raises, stopes, drifts) in the block are then taken from the files and their data taken off on the adding machine.

Results are tabulated on the 8½x11-in. ore-estimate cards, Fig. 7. The total assay-widths for each working place are given, together with the average assays for each place (calculated on the card). When all the assay widths for a given block have been set down on the card, they are added together, and the average assays for the

On the opposite side of the card is made a section of the block, scale 1:1000. After the estimate has been completed the cards are arranged in groups of four and the maps on their reverse side are photostated to the correct size for the completed annual report. In this way the lay-out of each block and the assays for each working in it are available for reference.

In addition, the entire section of each vein, containing all of the blocks, is photostated together with a tabulated record of the blocks giving tons, assays, and ounces and pounds of metal. The tabulation is made on a sheet of drawing paper with a Paysant pen, and simply laid on a blank space on the section. The result is a compact and inclusive report, easily compiled, since many of the data calculated for one year are available for the next, where the blocks have not been altered in the meantime by mining or development.

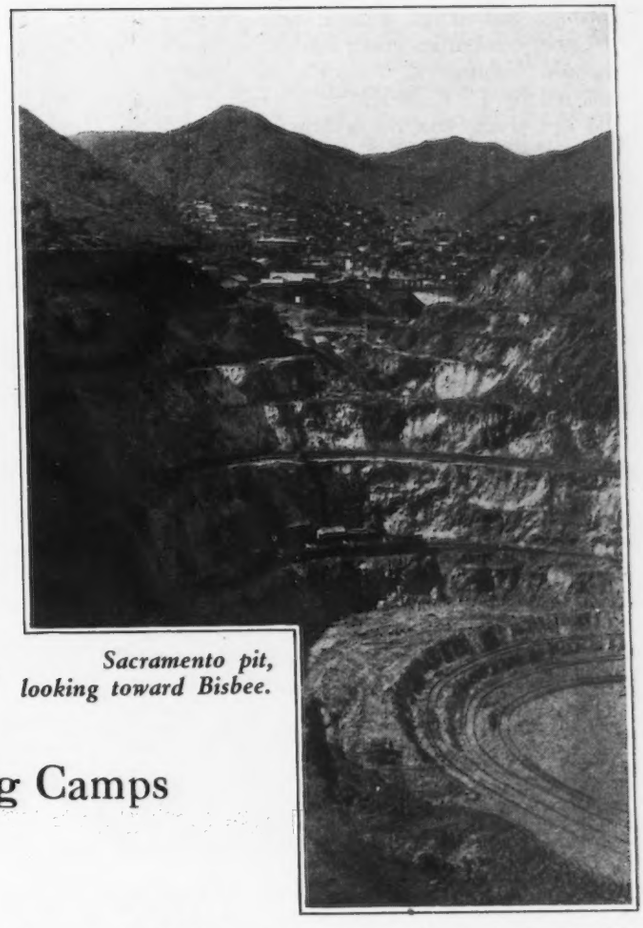
Flotation of Complex Idaho Ores

IN THE Moscow, Idaho, field office of the U. S. Bureau of Mines, attempts are being made to carry on a so-called preliminary flotation of complex lead-zinc ores at a relatively coarse grind. The object is to make a tailing at as coarse grind as possible to avoid high grinding costs and the loss of mineral in the slime produced when minus-200-mesh grinding is practiced. The low-grade tailing stage of the method has met with success. The next step is to make good-grade concentrates from the middling products produced.

In the Bisbee-Warren District

Part XVII:

Revisiting Arizona Mining Camps



Sacramento pit, looking toward Bisbee.

By E. H. Robie
Associate Editor

FROM Douglas to Bisbee is only 25 miles, and I chose the mining camp rather than the smelter town in which to pass a Sunday, especially in view of the fact that the Copper Queen Hotel offered better accommodations than were available in Douglas. Bisbee cannot fail to attract any visitor interested in the picturesque, built as it is on the mountain-sides, with the railroad and the long main street occupying most of the valley floor. To the north and east are the Mule Mountains and southwest are the Naco hills. Southeast are the adjoining towns of Lowell and Warren, where the valley widens out somewhat, with important mineralization extending down close to the edge of the plain where the Warren concentrator, the leaching plant, and the country club are situated. Bisbee, like many of the other well-established mining towns, changes little from year to year, but the atmosphere is different: to epitomize; Brewery Gulch is still there, but the name plates on each corner call it "Brewery Ave." The automobile has displaced the railroad for carrying passengers to Douglas and to Bisbee Junction, and a bus line goes up Tombstone Canyon toward Tucson.

Sacramento Hill has become Sacramento Pit, and a pit of no mean proportions, as a cursory glance at the accompanying view will show. I was told, my visit being six months ago, that about four years more would see the end of this great project, and that, after the removal of two more benches, glory-hole mining would be started.

In one brief working day—I left for Ajo on Monday night—there was little time to make any detailed inspection of the Bisbee mines and metallurgical plants. My first call was on D. D. Irwin, general superintendent of the Copper Queen Branch of the Phelps Dodge Corporation. Mr. Irwin has since resigned to become general manager of the Roan Antelope Copper Mines, in Northern Rhodesia, by which event the Southwest loses a charming personality and an able mining engineer, who, I feel sure, will add much to the prestige of Americans in that new and distant mining region. His successor at Bisbee is Joseph P. Hodgson. Among other things, Mr. Irwin told me of the sinking of the Warren exploration shaft to prospect the ore horizon between the 1,800 and 2,200 levels south of the Dividend fault. Lateral work is now going on from the 2,000 level. A heavy flow of water was struck last November, in sinking this shaft, so that grouting was necessary below the 1,800 level; as this water has been found very useful in extending the operations of the leaching plant, I am reminded of the poem by Bret Harte entitled "Dow's Flat," which told of the unlucky prospector who, in sinking a well, found a gold vein—"gold in the quartz" as Bret Harte wrote it, but "gold by the quarts" as I used to recite it. I remember the last two lines, which ran:

> "For 'twas water the derned cuss was seekin',
> And his luck made him certain to miss."

It was ore the P. D. was seeking, the conditions thus being reversed.

Mr. Irwin also told me of a mine timber truck that one of their foremen, John W. Scott, had designed, which has greatly simplified the transport of timber from the yard on the surface to the stopes underground.

Timber 9 ft. 6 in. long is loaded into the truck at the timber yard, lowered in the shaft, and transferred through the drifts without rehandling.

Other companies doing interesting work in this district include Calumet & Arizona, of which H. A. Clark, assisted by E. E. Whitely, is general manager. All of the ore there was being hoisted through the Junction shaft, this also being used for handling men and supplies in connection with the development of the Campbell area. Though I did not go underground and saw nothing of the Campbell discovery, I understand that it is living up well to early expectations. The Shattuck Denn has also been fortunate in its development, in the last year or so, in exploring the Denn ground under the leached zone on the 2,000 level; readers of *E. & M. J.* already know about this. The Shattuck mine is not operating its mill, shipping its lead ore to the Phelps Dodge Warren concentrator for milling.

All that is left of Sacramento Hill

The Copper Queen concentrator has been described by Ernest Wittenau, superintendent (*E. & M. J.*, Vol. 117, No. 21, p. 836-841), so I shall not go into details here. Two important changes have been made since that article appeared: balls have been substituted for rods in the secondary grinding mills, and tabling, which both preceded and followed flotation and made a finished concentrate, has been discontinued. Perhaps, though, some of the other changes are no less important.

I am assured that for primary grinding of 1½-in. material, the rod mills here have been perfectly satisfactory and will be retained. They were not so efficient as fine grinders for flotation, however, so balls are being used in the rod-mill shells with satisfactory results. Following the elimination of the tables, Dorr bowl classifiers were installed in open circuit, following the primary rod mills. The overflow from the bowls goes to flotation, and the sand to the secondary ball mills, using 2½-in. balls, which operate in closed circuit with Dorr drag classifiers. Seventy-five per cent of the flotation feed is through 200 mesh.

The flotation reagents consist of 0.08 lb. of pine oil, 0.08 lb. of potassium xanthate, and 5 lb. of lime per ton of ore. The lime is added dry, together with the ore to the primary rod mill. No advantage is seen here in using a milk-of-lime solution; Mr. Wittenau told me it merely made a residue to dispose of. As in other Phelps Dodge plants, with the exception of Nacozari, the Forrester cell has been adopted as standard, though one unit was equipped with the MacIntosh machine. The Forresters, of course, do not require nearly so high an air pressure as the old Inspiration type of cells installed here—about 1½ lb. instead of 5—but the same blowers are used, the decreased pressure resulting in an important power saving. The MacIntosh unit consists of two machines in parallel, the tailings from which pass to two other machines. Concentrates from all four go to a cleaner; concentrate from that goes to a recleaner, making a finished concentrate. The tailings from both the cleaner and recleaner go back to the roughers. This equipment of six machines does its best work on a tonnage of about 350 per day. Minerals Separation type of cells, with mechanical agitation, have also been tried at this plant; their sole advantage was an increase of about 1 per cent in the grade of the concentrate. The ratio of concentration now secured is about 9 to 1, compared with the 4 to 1 for which the plant was designed. Such is the advance made in the art of dropping iron and gangue.

The method of disposing of the flotation concentrate is out of the ordinary. It is laundered to a rake classifier making a sand and slime product, the former amounting to about 33 per cent of the total. The slime overflow is thickened and then filtered; whereas the sand passes to Blaisdell tanks with vacuum bottoms, and is allowed to settle for eighteen hours, after which time it contains about 5 per cent of moisture. The combined concentrate is shipped to the Douglas smelter.

Not much has been heard about the lead concentrator, which is housed in an adjoining building, though some very high-class work is being done here on oxidized ores from both the Phelps Dodge and Shattuck Denn proper-

ties. The product forms an important part of the supply to the lead smelter at Douglas.

The ore is first crushed in a jaw crusher, the product of this going to a Symons cone crusher where it is crushed from 4 in. to ¼ in., the ore then passing to a No. 75 Marcy ball mill in closed circuit with a Dorr drag classifier. Here, as in the copper mill, 2½-in. balls are used. Minerals Separation flotation machines are used, chiefly because mechanical agitation is desired on oxidized ore. Very little subaëration is utilized, however, as the air thus introduced is said to have an undesirable oxidizing tendency.

The function of the flotation machine through which the pulp first passes is to float as much as possible of the gold and silver that is associated with the gangue rather than the lead. The tailing from this first unit is then treated with additional reagents, and passes to the second machine, where as much as possible of the lead is floated.

A list of all the reagents that have been used at one time or another would read almost like the inventory of a chemical laboratory. I shall here merely confine myself to a brief catalog of some that were employed at the time of my visit, the place where they were introduced, and their purpose.

Sodium sulphide—This, of course, is used for the purpose of putting a sulphide film on the particles of lead carbonate mineral in order to secure the desired floatability. It is utilized largely as an addition reagent in the tailing from the first machine.

Sodium silicate—Half of the sodium silicate used is put in the ball mill, and half at the head of the second machine. It acts as a flocculating agent for the sulphidized mineral and as a deflocculating agent for the gangue, aiding in making a cleaner concentrate in the second machine. About 1 lb. per ton is a fair quantity of this reagent.

Eureka No. 70—This is a relatively heavy sulphuretted oil of patented composition, put out by the Eureka Metallurgical Company, of Salt Lake City. It is added both to the ball mill and to the head of the second machine.

Lewis tar oil—This is also added both in the ball mill and at the head of the second machine. It is obtained from the F. J. Lewis Manufacturing Company, of Chicago.

Barium carbonate—This is not always needed, but is added at the head of the second machine if necessary to disperse slime.

Soda ash (sodium carbonate)—This is not usually required on Shattuck ore, but sometimes better sulphidization is obtained on Queen ore by adding this reagent at the ball mill. It is also added at the head of the second machine.

Sulphuric acid—If the ore is very dirty, acid is sometimes added before the lead flotation.

Because of the use of such a diversity of reagents at different points, it is not feasible to recover any of the water, the entire mill supply being fresh. The copper concentrator, on the other hand, requires only about 20 per cent of fresh make-up water.

Exceptionally good recoveries are made, considering that the ores are oxidized. About 92 per cent of the lead is recovered on Shattuck ores; Queen ores are more refractory, 80 per cent being about the best that had been done, as regular practice, last spring.

Heap leaching of oxidized copper ores is practiced at an adjoining plant on the hillside near Warren, Claude H. Compton being in charge of this department. The practice has already been described, so I shall not repeat details. Leaching continues on a heap for seven years, the first and test section of one heap to be treated still having three years to go. A second leaching dump, containing 1,300,000 tons, received the first water this spring.

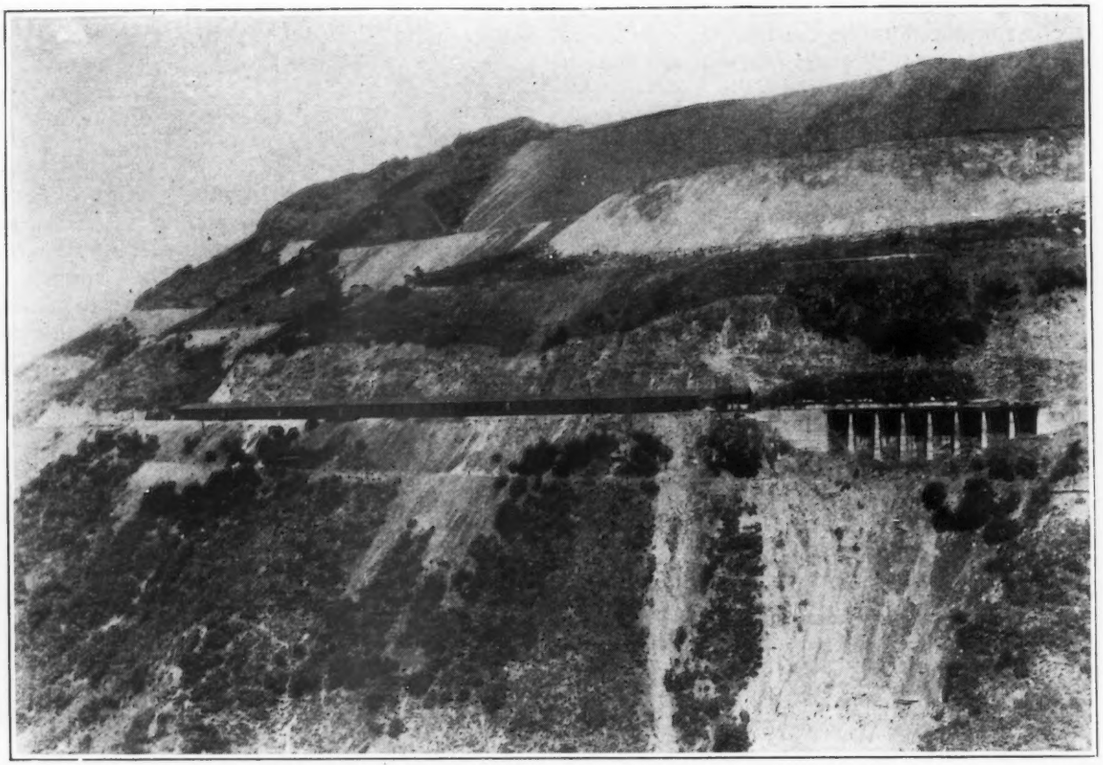
Diamond Production Now More Widely Distributed

BEFORE the war, out of a world's production of about 6,600,000 carats of diamonds, the South African mines produced about 76 per cent; of the remainder, 3 per cent was from South African alluvials, 19 per cent from German Southwest Africa, and 2 per cent from the rest of the world. But the record for 1927 is radically different, says Dr. George F. Kunz in a chapter on precious stones in "Mineral Industry," just published by the McGraw-Hill Book Company; out of a total production of nearly 7,000,000 carats the South African mine production was only 34 per cent; South African alluvials accounted for 33 per cent; other African production was 30 per cent; and the rest of the world 3 per cent. All of this enormous change in the South African alluvials has come within the last two years, but the change on the other African production has been gradual. The output of Southwest Africa has never been as large since it came under British jurisdiction as it was under German, but this drop has been more than balanced by new production from other localities, particularly the Belgian Congo, beginning in 1913, Angola in 1916, the Gold Coast in 1920, and Tanganyika in 1925. In other words, instead of being divided into four parts, of which the South African mines supplied three parts and the rest of the world one part, the diamond production is now divided into three parts, one each for the South African mines, the South African alluvials, and the rest of the world; and of this last part, 90 per cent comes from other parts of Africa outside of the Union of South Africa.

By far the largest portion of the increase in production of alluvial stones came from the vicinity of Lichtenburg, which accounted for about 85 per cent of the year's alluvial output. The next most important area is the Namaqualand field in the neighborhood of Alexander Bay, at the mouth of the Orange River. This western coast has been a producing section for about twenty years, particularly to the north in Southwest Africa, but little attention had been paid to the Cape coast south of the Orange River, except for a little work around Port Nolloth. Late in 1926 work was started at Alexander Bay, and this soon resulted in the discovery of what have been pronounced the richest alluvial finds in diamond history.

Copious statistical data and hitherto unpublished comment on precious stones are given by the gem expert of Tiffany & Company in the article mentioned. For instance, it is not generally known that sapphires of an industrial grade are being mined at the rate of about 20,000 oz. a year by the American Gem Syndicate on the west fork of Rock Creek, in Granite County, Mont. Two pits are equipped with hydraulic elevators and giants.

Utah Copper's New Precipitating Plant



Looking east across Bingham Canyon toward the new central precipitation plant. One of the dumps being leached is seen above the plant.

Many Improvements Introduced Over Former Methods of Treating Bingham Surface Waters

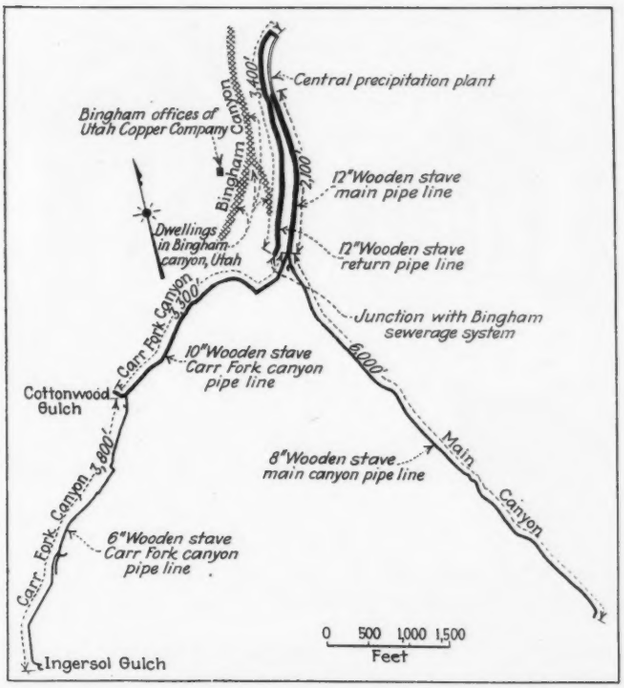
By H. D. KEISER
Assistant Editor

NUMEROUS IMPROVEMENTS in the application of a long-established metallurgical process are found in the new central precipitation plant that the Utah Copper Company placed in operation recently on the east side of Bingham Canyon, Utah. Although precipitation of copper from natural surface waters, following their percolation through overburden and dumps of waste rock, has been practiced at the Bingham property of the company since 1917, these operations, until this year, have been on a small scale and largely of an experimental nature.

Operations at the new plant began on March 26, and, during the period to June 1, the average flow treated was 1,000,000 gal. in 24 hours. Plant heads averaged 20 lb. of copper per 1,000 gal., from which an extraction of 97.5 per cent was made, tailing averaging 0.5 lb. of copper per 1,000 gal. The average grade of precipitate produced was 87 per cent copper.

Contents of the company's dumps on the mountainsides and in the canyon gulches near the Bingham mine are estimated to be 87,000,000 cu.yd. The copper assay value of the various dumps ranges from 0.3 to 1 per cent, 50 per cent of the copper being in the form of chalcocite, 30 per cent covellite, and 20 per cent chalcopyrite.

When the natural surface waters have percolated through the dumps, they are conveyed to the precipitation plant by a copper-banded wood-stave gravity pipe-line system, the main trunks of which total 15,200 ft. in length. At the plant the entire flow is split equally be-



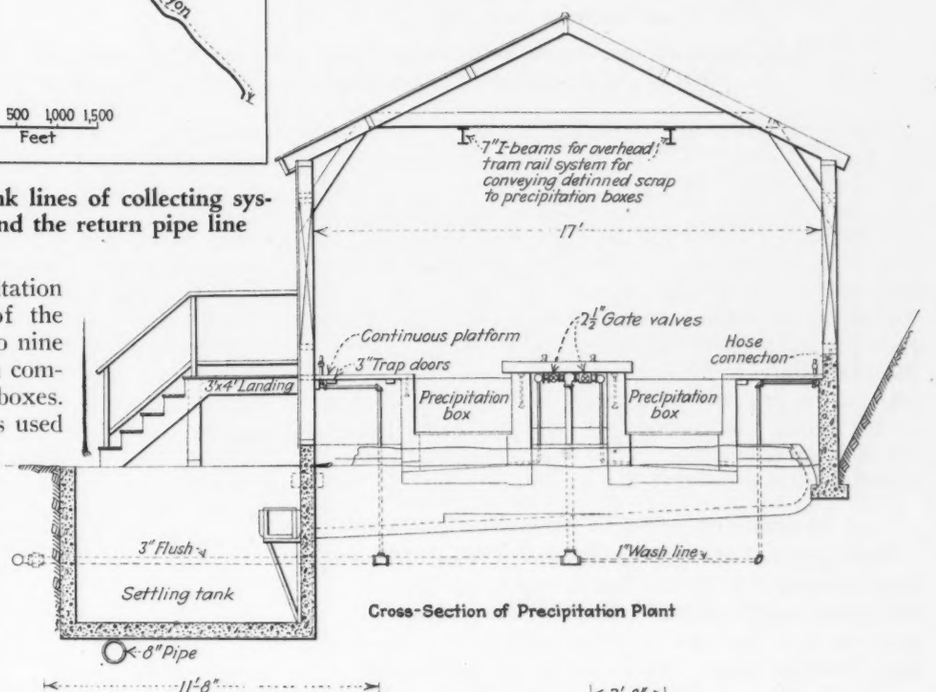
Sketch map showing main trunk lines of collecting system, the precipitation plant and the return pipe line

tween two rows of precipitation boxes, extending the length of the plant. Each row is divided into nine 80-ft. sections, and each section comprises four 20-ft. precipitation boxes.

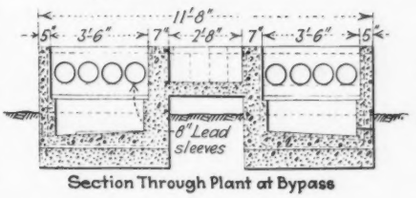
Detinned iron scrap, which is used as the precipitating agent, is heaped into the upper chamber of the boxes, as seen in the accompanying photographs of the interior of the plant. Consumption of this scrap is $1\frac{1}{4}$ lb. for each pound of copper precipitated. The per cent of extraction made in each 80-ft. section as the solution passes through the plant, and the cumulative per cent extraction, are shown in the graphs for the month of April that are herewith reproduced.

As the flow to the plant depends entirely on natural surface waters, the quantity of solution treated, and the velocity of the solution in the plant, vary according to the season. During the high-flow period, between March 15 and May 15, the flow at times exceeded 2,300,000 gal. in 24 hours, and the velocity of the solution was 18 ft. a minute. Whereas, during the low-flow season, less than 200,000 gal. enters the plant in 24 hours, the velocity in the one row then in operation varying from 4 to 5 ft. a minute. The quantity of solution treated is determined by readings taken every two hours of the depth of flow over a weir at the head of the plant. Precipitation boxes are cleaned out on an average of once a week during high flow, and once a month in the low-flow season, the sections at the head of the plant requiring more frequent cleaning than the others. An operating crew of sixteen men and a foreman is employed on each of three shifts during the high-flow period; this force is reduced in the low-flow season to one foreman and three men, working one shift.

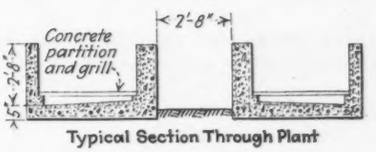
When the precipitate in the boxes of a section has built up to within an inch of the wooden grizzlies, the section is cleaned. Before beginning cleaning operations, the flow to the section is bypassed to the head of the opposite section in the other row. The flow from this opposite section is then split to the two following sections on either side of the plant. Wooden plugs are inserted in the slots at the foot of the section to be cleaned, through which slots a part of the flow normally passes to the following section. The pregnant solution remaining in the section is pumped over to the opposite section by means of a small electrically driven centrifugal pump mounted on a truck, which runs on rails laid between the two rows of boxes.



Cross-Section of Precipitation Plant

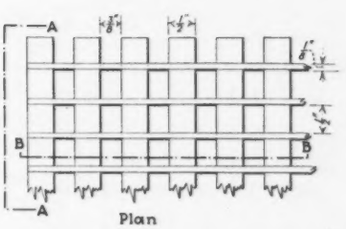


Section Through Plant at Bypass



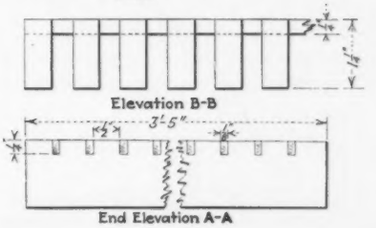
Typical Section Through Plant

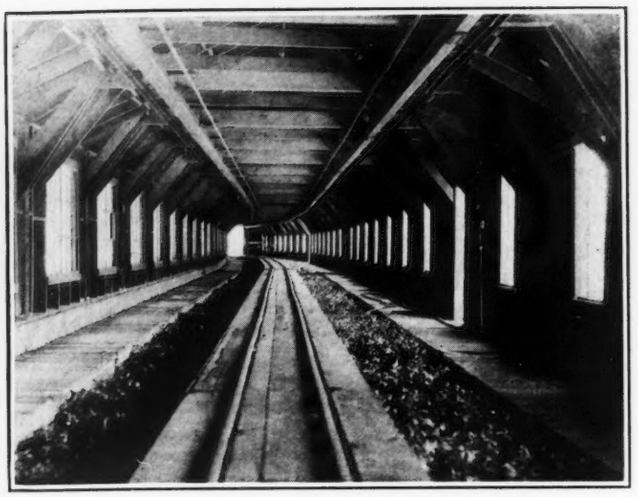
Above shows cross-section of the precipitation plant with details of typical sections



Plan

Right—Details of white pine grizzlies in the bottom of the precipitation vats





Left, interior view of precipitation plant, showing mounted centrifugal unit used in the pumping pregnant solution from one side of plant to the other during cleaning operations.

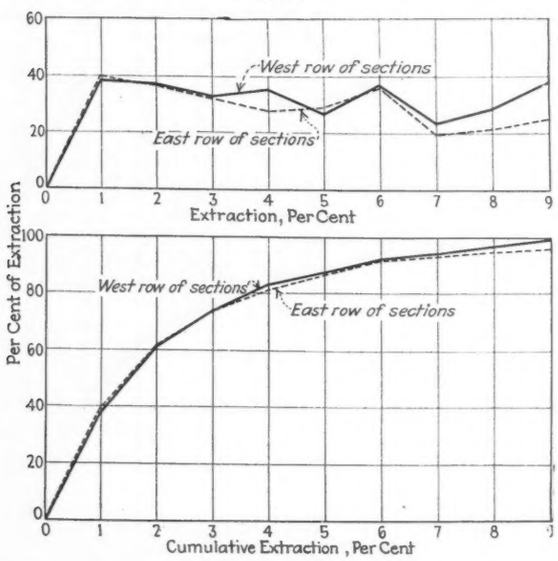
The overhead rail system used in conveying detinned metal scrap from the stock pile outside the plant to the precipitation boxes is seen in the interior view of the plant at the right

The four boxes in the section are then ready to be cleaned. Water at 250 lb. per square inch pressure is introduced along the upper sides of the precipitation chambers through ½-in. pipes spaced at 2-ft. intervals. All the jets in the section are controlled from one valve. The precipitate is flushed out of the precipitation chambers by the rush of wash water, and passes into launders leading to the settling tank that serves the two opposing sections, and which is alongside the building. When all the precipitate is flushed out of the chambers, the tin mat on the grizzlies is loosened, and fresh scrap placed in the boxes, the material in the mat being scattered through the new charge. The flow of pregnant solution is then resumed through the section.

Waste Returned to Sewage System

Precipitate in the settling tanks is allowed to accumulate to within 4 ft. of the top of the tanks, the water in the tanks overflowing at this elevation through slots at the foot, and then passing in launders to join the tailing flow from the plant. This mixture of plant tailing and overflow from the settling tanks is conveyed by a wood-stave gravity pipe line to the Bingham Canyon sewerage system. The precipitate, containing 25 per cent moisture and averaging 40 tons to each settling tank, is loaded by means of a clamshell into cars for transport over the Bingham & Garfield railroad to the Garfield plant of the American Smelting & Refining Company, where it is smelted.

Curves showing extractions effected in the successive sections of the precipitation vat, indicated by the digits from 1 to 9.



Continuous samples are taken of the plant heads and tailings, and of the liquor at the end of each 80-ft. section, by means of ¼-in. rubber-tube siphons. These siphons are introduced 1 ft. below the surface of the solution, and are fitted with adjustable clamps, so that a one-liter sample is collected in 24 hours. This sample is cut down to 8 oz., and then sent to the company's laboratory for analysis.

Chemistry of the Process

By the combined action of air and moisture the pyrite in the dumps is oxidized to ferrous sulphate and sulphuric acid:

$$FeS_2 + 7O + H_2O = FeSO_4 + H_2SO_4$$

The ferrous sulphate is oxidized to ferric sulphate:

$$2FeSO_4 + H_2SO_4 + O = Fe_2(SO_4)_3 + H_2O$$

This ferric sulphate reacts with the chalcocite (Cu_2S) in the dumps, forming copper sulphate, ferrous sulphate, and cupric sulphide:

$$Fe_2(SO_4)_3 + Cu_2S = CuSO_4 + 2FeSO_4 + CuS$$

The cupric sulphide formed then brings about the reaction:

$$Fe_2(SO_4)_3 + CuS + 3O + H_2O = CuSO_4 + 2FeSO_4 + H_2SO_4$$

In the process considerable ferric and ferrous sulphate in solution is produced in the dumps, and, as the dumps are mostly quartzite (an acid rock), an excess of iron salts in solution prevails in the flow to the plant. The first reaction at the plant is between the unreduced ferric sulphate and the scrap, resulting in the formation in solution of a large amount of ferrous sulphate:

$$Fe_2(SO_4)_3 + Fe = 3FeSO_4$$

Precipitation of the copper is brought about by the following electro-chemical reaction between the scrap and the copper sulphate in solution:

$$Fe + CuSO_4 = FeSO_4 + Cu$$

I am indebted to Louis S. Cates, vice-president and general manager of the Utah Copper Company, for permission to prepare this article, and to L. S. Breckon, geologist, and G. C. Earl, mining engineer, of the company, for the information and sketches that the article contains. Grateful acknowledgment is also made to H. L. Garrity, safety engineer, of the company, who furnished the photographs, and to L. G. Grooves, foreman of the precipitation plant, who explained in detail the operations at the plant.

A Plea for More Quantitative Studies in Geology

IT HAS been habitual among geologists to record relative or qualitative accomplishment in geologic processes. We say "this topography is older than that," "resistant rocks weather more slowly than soft ones," "this volcano has erupted more than that one," but we are not able to say how old in years or geologic periods either piece of topography is, how fast either rock weathers or how long any volcano has worked to build its cone.

Qualitative studies must needs come first, and no doubt we shall do qualitative work for many years yet; but I want to show in this paper some of the places in which much more accurate studies can be carried on. Our qualitative work has been excellent and large in amount and has laid the lines for valuable deductions and stimulating interpretations, but it is time for us to turn over a new leaf in the nature of our investigations. Stimulated by chemists and physicists who have been measuring quantitatively for many years, let us greatly expand our activities in making accurate determinations of our geologic processes, of their rates of accomplishment, and of their degree of continuity and variation in rate of performance.

Geologists have already done several things quantitatively. Crystals have been carefully measured and their unknowns calculated to the fourth decimal place or the seconds of arc. Chemical analyses of minerals and rocks have been made in great numbers. Mineral analyses or rocks have been done with considerable exactness. Stream measurements have been made revealing the actual velocities and volumes and changes in both elements; also showing the amount of matter carried in suspension and in solution.

For a number of years very careful quantitative observations have been made in the field of volcanism at the crater of Kilauea in Hawaii. The printed sheets issued each week may become a little monotonous, but they are telling how many earthquakes occur each day or week, how they are distributed in time, how intense or feeble they are, and their probable distance from the observatory. They record the slides in the pit, and the "working" of the floor and walls of the pit, the number of millimeters cracks have widened in a week, the colors and change of colors on the sides and floor of the pit. They tell of the displacement of bench marks as the volcano heaves and writhes in its development; they state how much the surface tilts day by day both in direction and in amount down to small percentages of seconds of arc. The studies endeavor to correlate the various volcanic phenomena with each other and with non-volcanic phenomena, as with tides and tide variations, with changes in atmospheric pressure, with earth disturbances in other places. Of course this sort of study and record will catch all the spectacular phenomena, but it is the infinite detail and accuracy of these routine items that in the long run will give us a new and better understanding of volcanism at Hawaii.

We have measured the rate of recession of falls in a few instances. Every one knows of the careful work covering a hundred years that has been done on Niagara. But here the object was as much or more to develop a measuring stick for geologic time as it was to get at the rate of progress. Two or three other falls have been similarly studied.

Twice have valleys of small streams been studied. Measurements of the actual erosion occurring in a given time in a limited part of the stream and valley were made; then careful measurements of a larger section of the whole valley were made and the two results set down in ratio. Again the study was made in each case much more to acquire a measuring stick for post-glacial time than to disclose just what the stream is doing in the nineteenth or twentieth century.

Nearly thirty years ago a series of observations were made on artificial structures in and around greater Boston. The observer was able to find the dates of making the structures and the condition of the structure when made. He then took photos and conducted measurements of the structures and estimated what nature had been able to do in known periods of years. Walls had been heaved or bulged, slopes had crept, flagstones had been worn, monuments weathered almost to the effacement of inscriptions, and scores of other changes had been made. These were accurate measurements of actual processes in geology. But the very fact that we can and do single these little programs out and thus exalt them is ample evidence that we are not in the habit of thus seeing quantitatively.

Why shouldn't we measure scores of falls in many kinds of rocks and under different climatic conditions and leave our records for some successor? Then he could repeat the measurements and from the two series deduce conclusions. Why can't we measure many post-glacial, as well as other, streams with their valleys in drift or in coastal plain rocks or even in crystallines, and file our results with some permanent institution, and let some one else repeat the measurements in fifty years and check up on rates of work? This study need

Abstracted from an address by George D. Hubbard before the Geology Section of the Ohio Academy of Science.

not be done solely to get a time measurer, but to learn rates of work.

Nearly 25 years ago a member of the U. S. Geological Survey spent some time with surveyors in the Great Lakes region tying in a series of accurate bench marks with the lake levels. He has gone on. His records are in the Survey archives. I believe the plan is to have the bench marks and lake levels again surveyed in 25 or 26 years more and the results checked against the earlier survey. It is said that if there is a tilt of an inch in one hundred miles in any direction these observations will detect it. Then we shall know if the Great Lakes area is in motion in the first half of the twentieth century; the direction and amount of motion if detectable will also be made manifest. Now why not do this sort of thing in many places? Shore lines of long bays, the Baltic, Adriatic, Gulf of California and Chesapeake Bay would be serviceable. Dr. Karl Sapper said not long ago, "The most important goal for the future of volcanology is to obtain new collections of facts and make them available, for only by such procedure can a substantial basis be made for more satisfactory interpretations than have hitherto been invoked." Why not extend the careful quantitative study of volcanoes now under way at Hawaii to at least a score of volcanoes in different types of regions, with diverse character of eruption, other kinds of rock magma, and other relations to land and sea? Such a series of observations over a period of 50 years would help to reach Dr. Sapper's suggested goal. How can we expect to make much further progress in volcanology on qualitative observations and these limited to a half dozen volcanoes? We are not cultivating the field anything like so intensively as many of our agriculturists work theirs.

What do we know about viscosity of lava? Several statements from recent works are quoted below. "Lavas low in silica may flow like water; lavas high in silica are more viscous." "As cooling progressed, viscosity or stickiness of the substratum kept increasing." "The increasing pressure (toward the earth's center) could not fail to develop high viscosity."

The author gives no reference, no evidence, and no measurements, nor are there given in any of the above references a suggestion even of a ratio, to say nothing of the actual rates and values. Some of these items may be subjected to experimentation. Rate of flow of different lavas could be measured, at determined temperatures, and with calculated cross-sections and gradients; then the values could easily be checked against the calculated or measured rate of water flow under similar conditions. The viscosity of water is known. Then we should have some specific ratios which would possess actual values.

Possibly we could study the viscosity of lavas made up with specific compositions and heated to desired temperatures. The following statement is taken from a well-known textbook: "Where the saturation (of the water) is but little above that of average ocean, animal life becomes scarcer and molluscs make thicker and rougher shells." It seems simple to test the matter out and see how much the saltiness has to be increased to make certain appreciable reductions in the numbers of animals, and to ascertain how much thicker and rougher molluscan shells become with definite increases in the saltiness of the water. We have a considerable number of meandering streams of various sizes and on various grades with measurable velocities, loads, and volumes. It would be instructive to make quantitative studies of say twenty or thirty streams over a period of years to learn the rate of growth of meanders under the several conditions, the rate of migration of meanders, the size attained by meanders in the different streams before they cut themselves off, the frequency of meanders, and other items on the behavior of meanders. We shall never be able to meet successfully the problem of Mississippi River control until some one knows quantitatively much more concerning the pertinent facts with relation to the physiography of the river.

WHAT is the rate of solution of limestone? Of dolomite? What is the rate of weathering of feldspars? Of olivine, hornblende, or enstatite? What do we know about the viscosity of lava? Why shouldn't we measure scores of falls in many kinds of rocks and under different climatic conditions, and leave our records for some successor? Why can't we measure many postglacial as well as other streams with their valleys in drift or in coastal-plain rocks or even in crystallines, and file the results with some permanent institution; and let some one else repeat the measurement in fifty years and check up on the rates of work? These and many other questions are asked by the author of this article, who urges that "Stimulated by chemists and physicists who have been measuring quantitatively for many years, let us greatly expand our activities in making accurate determination of geologic processes, of their rates of accomplishment and of their degree of continuity and variation in rate of performance."

The mechanics of faults have been worked out pretty largely on an empirical basis. Let us now measure the rate of movement, direction of movement, frequency and continuity of movement along several active faults and thus add somewhat to our knowledge of faults and possibly as much to our ability to interpret and understand them.

Rocks weather at vastly different rates. What is the rate of solution of limestone? Of dolomite? What is the rate of weathering of feldspars? Of olivine, hornblende, or enstatite? By controlling conditions and making regular accurate measurements we can add to our knowledge of weathering.

We have often made estimates of the rate of sedimentation of sands for sandstones, clays for shales, and calcium carbonate for limestones. It is now possible to make accurate measurements of the depth of water in lakes, marshes, and shallow seas, then resurvey after a period of years, and thereby to discover the actual rate of sedimentation under these conditions. One such study would be valuable, but a score of them would remove some of our guesswork and crude estimates. Some of the Finger Lakes in New York State, western Lake Erie, or Ontario in parts might be thus studied. Lakes in Europe would also be admirable for such studies.

Chesapeake Bay would seem to be a promising sea to investigate. Lake Pontchartrain has an interesting story to tell. Reefs off the coast of Florida, Cuba, Yucatan, and the Bahamas might give good results on the rate of reef building.

Shore lines can be carefully surveyed or measured both where cliffs occur and where beaches are building, as well as along delta fronts. New surveys fifty or one hundred years after would give worth-while checks on rates of progress. Most of our knowledge of such matters is coached in such terms as "rapid erosion," "slow building forward" and "intermittent cutting and filling along the beach."

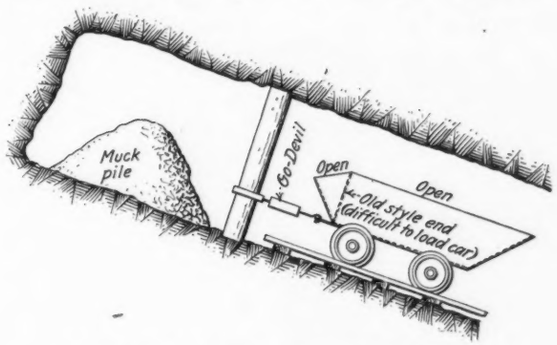
Of course, no one man could complete any of these studies, but institutions could initiate them and carry them on. Individuals could make first surveys and will their programs and data to some institution able to take the work over. Then some other man could later continue the work. Some of these problems should be carried forward at intervals for hundreds of years. It is a long look ahead, but geology, which gazes far back, should also have courage to plan far ahead.

Reduction of Magnetite by Iron Sulphide

AN investigation of the rate of reduction of magnetite by ferrous sulphide has been completed by the U. S. Bureau of Mines. This is the first of a series of studies of copper smelter furnace reactions undertaken by the Southwest Experiment Station at Tucson, Ariz. The results show that pure magnetite is reduced to some extent by ferrous sulphide at temperatures as low as 1,000 deg. C. and that the reduction may become almost complete in two hours' time at 1,300 deg. C. if there is a considerable excess of sulphide and if sulphur dioxide, sulphur trioxide, and elemental sulphur reaction products are removed as fast as formed. When these products are allowed to accumulate, the rate of reduction is lowered.

Changes in Go-Devil Car at North Star Mine

AT THE North Star mine, Grass Valley, Calif., the box type of go-devil car used in the stopes which are relatively flat has been modified from the square-ended box formerly used to the design shown in the accompanying sketch. The back plate is terminated at about one-half the box height. This makes it easier to shovel into and enables long stulls to be more readily handled.



North Star's new type of go-devil car

New Method for Quicksilver Analysis That Is Simple and Reliable

SEVERAL volumetric methods for mercury have been proposed, but all are objectionable because of the difficulty of getting the metal into solution and the roundabout methods employed, writes Letus S. Strickler, of San Francisco. The Eschka method is simple and direct but not of universal application because of the interference of organic matter and free sulphur.

The following modification, using the Whitton apparatus, is in use in Mr. Strickler's laboratory and is offered as simple, rapid, and reliable. Free sulphur (up to 150 mg.) in the charge and organic matter do not interfere. The method is based on the affinity of metallic silver for sulphur and the property of cupric oxide of decomposing hot organic gases.

The silver is prepared by reducing the chloride with aluminum or zinc, washing, drying and screening through a 40-mesh screen. The cupric oxide is prepared, as proposed by George A. James, as follows: To about 150 c.c. water add 5 or 6 grams copper sulphate. Warm. When dissolved add 2 or 3 c.c. sulphuric acid. Then add 5 or 6 oz. iron filings, sized minus 40 plus 80, stirring vigorously. Several such batches may be prepared. It is more satisfactory to work with small quantities. The copper-coated iron is then washed, dried, and placed in an open iron pan and heated for several hours over the naked flame of the hot plate, stirring occasionally. Each particle of iron is coated with a layer of copper oxide, the greater part of which is cupric. This is hygroscopic and should be kept in a stoppered bottle.

For an average ore take the following: 5 or 6 grams of the copper oxide; about 2 grams calcium oxide; ore charge. Mix thoroughly and cover with the copper oxide. For an ore containing much organic matter increase the cover.

For an ore containing over 4 per cent elemental sulphur take the following: copper oxide 5 to 6 grams; silver powder 2 to 3 grams; calcium oxide 2 to 3 grams; ore charge. Mix thoroughly and cover with alternate layers of copper oxide and silver powder.

Checks should be run with different quantities of ore, such as one gram against 2 grams, half a gram against one gram.

The silver powder and the copper oxide, as prepared above, are porous and offer the largest possible surface to the gases.

Mr. Strickler finds it safer to keep the foil at a lower temperature than advised by Whitton. A piece of small brass tubing is soldered into the side of the cooling dish near the top for an overflow, and water is fed into the dish with a piece of rubber tubing from the hydrant. With this apparatus, some moisture in the charge is necessary to insure the mercury amalgamating with the silver foil. With a dry ore, add two or three drops of water to the charge. Too much water will give low results. The mercury condenses on the drops of water on the foil and is lost, or, in case the foil is covered with a film of water, the mercury cannot reach it. Only a sufficient amount to insure amalgamation should therefore be used.

The foil should always be ignited before being used and should be kept clean and bright. Overheating will cause it to become coated with a film of iron and other stains. These are easily removed with a little flour emery on a damp cloth.

COMMENT AND CRITICISM

Engineering Work Demands Professional Co-operation

Skilled and Experienced Geological Advice Is an Essential Preliminary to Many Types of Development and Construction Projects

THE EDITOR:

Sir—I think that the editor ought to fight my battle, inasmuch as he brought my poor comments on the St Francis Dam to the attention of Mr. W. H. Hampton, "mining and civil engineer and geologist," who has voiced his disdain in your issue of Sept. 15. It is with some embarrassment that I make reply through your columns, since my article was published in another magazine. However, Mr. Hampton must be answered. Plainly he represents, in some measure, the dangerous doctrines at which my original remarks were aimed.

Mr. Hampton professes ignorance of my special calling; but evidently he has guessed that I am a geologist, with an ax to grind in the "propaganda to declare the geologist in the combinations of the day"! As a matter of fact, I have even had something to do with dam sites, although I cannot boast the 50 years of varied experience claimed by my versatile critic. I did not "nose into the dam site business," but was invited into it—will you believe it?—by engineers, in spite of my ignorance of "what the field of civil engineering covers." But no doubt these are unworthy engineers, who have not yet learned that a "properly designed" dam can hang in thin air, and that any rock or other such rubbish in the vicinity has no conceivable function except to prevent the water from running out at the bottom.

As a matter of fact, these engineers of my acquaintance are not ardent advocates of the "tricky" arch dams. They design structures of the gravity type, conservative enough to satisfy any beaver. And yet (how shall we explain it?) they profess the astonishing belief that the rock beneath a dam is worthy of some study, and that a man who has lived with rocks may be able to help prevent future trouble with their structure. Mr. Hampton's warning makes everything clear. These rascally engineers have only drawn me into a trap. One of these days a dam in which I have taken a hand will fail, and then the geology of the site will be "made the goat"; all of the blame that belongs to defective engineering design will descend upon my credulous head!

The findings of Governor Young's commission, which included four engineers who are "expected to know something about supporting power of materials for foundations, stresses and strains and other essentials," have no validity in Mr. Hampton's experienced mind. This commission studied the problem carefully on the ground, and explained clearly not only the fundamental causes for failure but also the successive steps in the collapse. They found, for example, that the weakest spot in the foundation was near one end of the main structure; and that after failure of this portion the other end was subjected to undermining by the rushing water. Accordingly the two ends collapsed, and the relatively stable middle section remained standing. But Mr. Hampton, from his vantage point at a distance, knows better. The ends were on "*more* stable" material, and would have stood had defective foundations been the real trouble. Evidently the commission was too near the problem and could not see the forest for the trees.

We are therefore to depend on some one a thousand miles or so from the scene not only for an impartial analysis of the problem but even for a correct determination of the facts! If this is Mr. Hampton's drift—and I can draw no other logical conclusion from his remarks—then indeed I must admit that the real scope of the civil engineering field has been beyond my comprehension!

But let us analyze a bit farther. "This dam site foundation business has been run into the ground," and the design of the dam is the all-important consideration. But what is this we read from Mr. Hampton's pen—"There does not appear to be any particular concordance among eminent engineers in dam design"! Then what is our solution? Throw out the presumptuous geologist—he has no place in the dam business—and leave everything to the engineers, who know all about stresses, strains, etc. But to which engineers? Unfortunately these fellows who advocate the "tricky arch type" are permitted to experiment on a large scale, at the expense of a defenseless public. They are all out of step except Mr. Hampton, advocate of the safe "beaver type"; and obviously Mr. Hampton is not permitted to control the situation. Much comfort it will be to the public to know that geologists cannot help them, so long as they must live in the shadow of dams whose safety cannot be certified by the engineers themselves. As I think on these things a faint suspicion enters my mind. Perhaps this field of civil engineering, about which I know so little, covers so much that even most of the engineers themselves are in the dark on certain matters that are rather important. Only an occasional man among them can, with long experience, master the whole field, and, in addition, the small and unimportant subject of geology; and since the rank and file will not heed his wisdom, to all practical purposes his erudition is wasted.

Is it not true—or am I again merely showing my ignorance—that sound engineering and science have to start with a large element of common sense? In every project of the kind under discussion there must be a dam and there must be some sort of foundation; and the old adage about the weakest link applies to dams as well as to other earthly things. The engineer, if he is worthy of his profession, wants to have a large factor of safety in every element of the dam he builds. A man who is cocksure that he knows everything because experience has taught him something is a dangerous guide in building large public structures. Frankly, I am incredulous when anyone claims to know all that is worth knowing in both civil engineering and geology, particularly if he ends by saying that the geology of dam sites is of no importance. Regardless of any dispute among engineers as to the design of the St. Francis Dam, it is significant that some good engineers have joined in pronouncing the foundation seriously defective. Surely common sense requires serious consideration of this verdict.

It was announced recently that two prominent geologists have been appointed to serve with engineers in study of the Boulder Dam project. Evidently it is recognized in some quarters that geologists belong "in the combinations of the day" when large artificial reservoirs are under consideration. Geologists have no thought of attempting to usurp any part of the engineer's field. They will confine their attention to the geological prob-

lems in dam construction, and they are quite willing to assume their proper share of the responsibility involved.

CHESTER R. LONGWELL.

Department of Geology,
Yale University, New Haven, Conn.

THE EDITOR:

Sir—I do not hold with what W. H. Hampton says in his letter appearing in *E. & M. J.* for Sept. 15 under the heading "Geology and Dam Construction." Undoubtedly, had the city of Los Angeles made use of the services of geologists of repute, together with civil engineers well versed in dam construction, the fact that the eastern wall of San Francisquito Canyon is faulted would have come to their attention. Likewise, the nature of the walls and footing upon which the dam was built would have received careful and serious study, and the heavy loss of life and property would have been averted. The trained geologist would have discovered both the fault and the unfit nature of the material upon which the dam was constructed.

Possibly, where loss of life is not a factor, a "Hampton Beaver Dam" might answer the purpose. Otherwise, by all means let us have a real geologist connected, in a consulting capacity, with the choice of dam sites. F. F. HOOD.

Humboldt, Ariz.

Tin Resources of the United States

THE EDITOR:

Sir—I desire to submit the following list of the tin resources of the United States:

Alabama—Tin has been found in Coosa County, near Brockford, associated with tourmaline, biotite, and tantalite.

Massachusetts—Near Chesterfield and Goshen, cassiterite has been found, associated with tourmaline in pegmatite dikes.

Maine—Cassiterite has been found in the vicinity of Paris, Hebron, Winslow, and Stoneham.

Nevada—Cassiterite has been found in Lander County. The deposits were briefly described in *E. & M. J.* of Sept. 8, 1928.

North Carolina and South Carolina—This belt of tin extends from near Gaffney, Cherokee County, S. C., across parts of Cleveland and Gaston counties, N. C., to near Lincolnton, a distance of 35 miles. The cassiterite is distributed in pegmatite dikes. Two carloads of ore shipped to England in 1888 yielded 2½ per cent tin on the first and 1½ per cent on the second.

South Dakota—The tin deposits lie to the south and west of Custer, in what is generally known as the Nigger Hill district.

Texas—Cassiterite has been found on the east flank of the Franklin Mountains about 10 miles north of El Paso. The three veins occur in granite.

California — Temescal district, described in *E. & M. J.*, issue of July 28, 1928.

Virginia—Irish Creek district, which was briefly described in *E. & M. J.* of Aug. 22, 1928.

Other Localities — Alaska; Cook County, Wyo.; near Dillon, Mont.; and near Boonville, Idaho.

Very little seems to be known concerning our domestic resources of tin. No doubt tin exists in many localities other than those mentioned.

Geer, Va. MARSHALL HANEY.

Consultation

Flotation Terminology

"In visiting a western flotation plant recently I was interested in hearing the superintendent, a technical graduate, speak of the product of his rougher flotation cells as a 'rough' concentrate, and describe the final concentrate as a '50-oz. froth.' Can you advise me if these two terms are in general use throughout the industry?"

The nomenclature and terminology of any phase of industrial operations necessarily includes many terms and phrases that are acceptable only because of local necessity. A glossary of accepted mining and metallurgical terms contains many expressions that have originated in local usage. The test of acceptance appears to rest largely upon the need for a new term to describe something that cannot be otherwise described, or to describe it more concisely or more aptly. Common sense and the normal edicts of good taste likewise are factors involved in gaging the general acceptability of a popular local term.

The use of the term "rough" concentrate to describe the product of a preliminary flotation operation does not appear justified. Probably the application is purely local, and results from a careless habit of speech. The terms "rougher" and "cleaner," as applied to particular types of flotation concentrate, are generally accepted. They describe the relative grades of two products from one plant. The use of "rough" or "clean" concentrate is open to the objection that an empirical rather than a relative value is attributed to the product.

Calling a flotation concentrate assaying 50 oz. silver per ton a "50-oz. froth" is more common. However, sound analysis reveals little to commend the practice. An assay result is based commonly upon the dry weight of the material. Thus, though a concentrate may be wet or dry, remaining a concentrate in either condition, a froth is only a froth when it contains a large percentage of moisture. Upon drying, the froth loses its identity as such.

Few are guiltless of careless speech, but the incorrect use of words in technical writing is less excusable.

Copper Prices, 1860-1900

"In the last annual review issue of "E. & M. J." you published yearly average metal prices extending back to 1899. Can you give me copper prices extending back even farther, and tell me if there was any change made in the method adopted of obtaining quotations of the metal?"

Engineering and Mining Journal has published daily prices of copper, tin, lead, zinc, and silver since the issue of June 25, 1898. Before that, average monthly and yearly prices of these metals were compiled, and in the market comment the quotation for the week was published.

No electrolytic copper was offered in the metal market until the late 'eighties. In the early 'nineties it was becoming increasingly important, though the monthly quotations took cognizance of Lake copper only, until 1899. In the 'nineties, electrolytic copper ordinarily sold at a discount of from a quarter to a half cent from the price of Lake, which is given in the subjoined table. From 1899 to 1913 average prices of both electrolytic and Lake copper were compiled, but the strike in Michigan in late 1913 and early 1914 resulted in the absence of Lake from the market, since when average prices have been compiled for electrolytic only, though, of course, Lake copper has been an important factor in the Middle Western market, being sold on a competitive basis with electrolytic.

Average Prices of Lake Copper

1860 to 1900

In Cents per Pound

1860	22¼	1881	18⅛
1861	19⅛	1882	18⅛
1862	25⅞	1883	15⅞
1863	32¼	1884	13¾
1864	46¼	1885	11⅝
1865	36⅛	1886	11
1866	31⅜	1887	11⅛
1867	25⅛	1888	16⅜
1868	23⅜	1889	13⅜
1869	23⅜	1890	15⅜
1870	20⅝	1891	12⅝
1871	22⅝	1892	11.55
1872	33	1893	10.75
1873	29	1894	9.56
1874	23¼	1895	10.76
1875	22½	1896	10.88
1876	21	1897	11.29
1877	18⅝	1898	12.03
1878	16½	1899	17.61
1879	17⅛	1900	16.52
1880	20⅜		

The lowest price on record for copper was reached in 1894, when the metal sold as low as 9c. And yet *Mineral Industry* for that year says, "Even the very low price of 1894 was not without a fair profit to the majority of our producers." Efforts were made to restrict production, but no concerted plan was accepted. However, "the Anaconda company, of its own accord, agreed to reduce its monthly output from about 5,000 tons of fine copper to about 3,000 tons, and the reports given out for the months of November and December have shown that it has lived up to this declaration, although at the time it was received by the trade with great incredulity."

INDUSTRIAL PROGRESS

Economics of Aërial Photography

Misconceptions as to the Cost of a New Tool May Hinder Its Utilization

By E. R. Polley

Vice-President, Fairchild Aërial Surveys, Inc., New York

MUCH has been written and published on the subject of the cost of aërial photographs, but if a student could assemble all the articles and then read them consecutively, the contradictory nature of the data would be apparent. At a matter of fact, each writer has viewed the subject from his own angle, and the types of articles published range from that of the city-planning engineer to the forester, from the real-estate operator developing a golf course of 100 acres to the viewpoint of a geologist using aërial photography for the mapping or study of an area as extensive, perhaps, as one of our entire states.

In short, the inherent characteristics of aërial photography and its great flexibility permit it to be used for a multitude of purposes. The remarkable advances made in the design and construction of aërial cameras, together with the refinements of photographic films and papers, now permit photographs of such remarkable clarity and detail that the picture has a wide use. Every detail of the terrain is shown, so the result is valuable to the forester interested in details of trees, to the city planner concerned with houses and sidewalks, to the geologist looking for rivers, drainage, faults, or whatever pertinent data are visible from the airplane that may disclose to him the minerals, oil, or other commodity of value he wishes to locate.

The confusion that exists is no justification for condemning aërial photography; it merely proves that the subject is so broad that it is necessary for the technical man to familiarize himself thoroughly with general principles and, in addition, specialize in the application of the new "tool" for his particular problem. Incidentally, an engineer needing any kind of a map is not up to date unless he educates himself so as to be able to make the fullest use of aërial photography in securing information of value.

Erroneous impressions have been given by some writers on aërial photography, because they have endeavored to cover entirely too much ground and did not limit themselves to particular problems. This is especially true as regards cost; although commercial aërial photography is now over ten years old in the United States, many engineers have yet to apply it for the first time, and they naturally hesitate to embark on aërial photographic service without a definite idea of the cost. The inquiry as to cost often precedes even a brief description of the engineer's needs or purpose, and obviously is as impossible to answer as the question: How much does a building cost?

A 300-page textbook would be necessary to picture accurately and explain all the factors that influence the cost of aërial photography in the many forms it is used. There are, for instance, the exploration map, the information survey, the overlapping oblique service, the rough mosaic, the controlled mosaics, and the precise aërial photographic map. These various services again may be made at scales ranging from 1 in. equals 50 feet to 1 in. equals one-half mile. Again, the location of the territory, the size of the area, and the particular hazards of flying owing to climatic conditions must be given proper consideration in determining the cost of a project. Obviously, it is a courageous man who submits general cost data, and such data are virtually of no value.

The cost of making the type of aërial photographic map demanded by a city planner is different from the cost of the aërial photographic service needed by the geologist. Accurate specifications as to the exact aërial photographic service expected should be stated when costs are mentioned. Furthermore, it must be borne in mind that cost figures compiled according to the cost-accounting methods of government bureaus and expeditions differ from the figures compiled by the cost accountants of efficient corporations. In fact, the only entirely dependable cost data will be the actual prices charged by an experienced and reputable aërial photographic mapping concern. These prices represent the outlay the technical man must ask his principals to pay.

To give some examples of the variation in cost the following examples are given:

Example 1—The city of Trenton, N. J., ordered a controlled mosaic for the use of its planning engineer, comprising 30 square miles; views to be taken in November and December; the map to be delivered at a scale of 1 in. equals 400 ft., mounted in one sheet on cloth to roll. The price of this map was about $3,000 and the cost per square mile about $100.

Example 2—An area of 2,000 square miles, in southern Texas. No map to be delivered. Requirement consisted only of vertical aërial photographs overlapping one another, and their rough assembly. The purpose was to show pictures without an attempt to hold to any accurate scale for the complete area, for use as a general reconnaissance of the area for geological purposes. The work was required to be done in the early part of the year. It was flown with a 6¼-in. lens, the airplane being at a height of about 15,000 ft. One set of pictures was delivered. The price of this work was about $8 per square mile.

Example 3—Western part of the United States. Area approximately 100 square miles, territory mountainous; flown during mid-summer; delivery consisted of a precise aërial photographic map, giving the maximum possible accuracy. Scale 1 in. equals 1,000 ft. It was important that the photography be the very best possible. Therefore, it was flown with a long focal-length lens, and extreme care was taken in the handling of all photographic products and in the assembly of the map. The price of this map was about $200 per square mile.

The foregoing examples are quoted to demonstrate the fallacy of accepting any particular published figure as an indication of the cost involved on a specific problem, not with the intention of hoping to educate the technical man as to what to expect in prices. For the same service, not only do prices vary a great deal, because of the different locations of the territory, but often an investigation of a particular problem by a competent aërial photographic expert indicates another type of service to be more efficient.

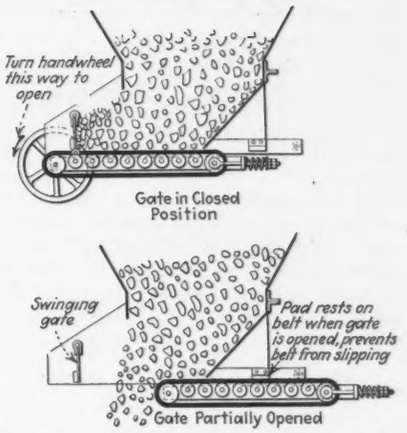
The commercial firms engaged in this work appreciate these facts and submit estimates. The sensible procedure is for the technical man to request such estimates after supplying complete data, including the exact location of the area and the problem confronting him. If already experienced in the application of aërial photographic service, he can specify exactly what he requires. If not experienced, he can ask that accurate specifications be given him of the aërial photographic service to be delivered, together with the price. His next move would be to submit such specifications and prices to one or more consulting engineers who specialize in this work, requesting an unbiased report. The cost of so doing would not be great.

The mass of data published would

seem to indicate that an aërial photographic service is desirable, regardless of the problem. This, of course, is ridiculous; but there is some basis for this feeling, because of the wide application of aërial photography and the new uses continually being found for it. It is wise for a technical man to make careful inquiries into the possibilities of saving money by making use of aërial photographic services on almost every type of project, for the reason that, after receiving a definite commercial quotation, his own common sense will tell him whether the proposition is practicable or not. If photography does apply, the savings are tremendous. If it does not apply, the cost is obviously prohibitive.

It must also be borne in mind that data secured by aërial photographic means or maps made by this method do not simply supplement or take the place of usual methods. Aërial photography is a comparatively new tool, somewhat revolutionary in its applications. It almost invariably gives all data that a map gives, but in addition it gives a great deal more, because of the detail that can be registered in an aërial photograph. In many instances, aërial photography gives data and information otherwise impossible to secure, and the value of new data disclosed by aërial photography has often surprised those who have taken advantage of it.

The object of this article is not to educate the engineer as to how he can use aërial photography, but rather to emphasize the fact that it has saved money in so many different applications that it usually repays an investigation. Also that cost must be estimated for each project. General cost data should be viewed with suspicion.


Turn handwheel this way to open
Gate in Closed Position
Swinging gate
Pawl rests on belt when gate is opened, prevents belt from slipping
Gate Partially Opened

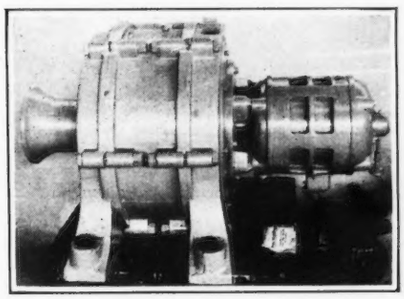
Sketches showing bin gate in operation

The Equipment Review

EQUIPMENT recently announced by manufacturers includes several machines and devices of application in the mining and metallurgical industries. These are described at varying length in the following paragraphs:

Powerful Car Puller Designed

One of the accompanying illustrations shows a horizontal capstan car puller built by Stephens-Adamson Manufacturing Company, of Aurora, Ill., to spot



Car puller, used by Anglo-Chilean Consolidated Nitrate Corporation, develops 6,000-lb. rope pull at 50 ft. per minute

loaded cars in the South American plant of the Anglo-Chilean Consolidated Nitrate Corporation. The machine was designed for highest possible efficiency and safety for operators. All gears are inclosed in the cast-iron housing, and the only moving part exposed is the slow-moving horizontal capstan. A compact arrangement of the gears makes possible a reduction of 40 to 1 reduction in the comparatively small housing. In addition, the electric drive motor is mounted as an integral part of the puller, which requires but four base bolts to mount.

Driven by a 10-hp. motor, the car puller develops a 6,000-lb. rope pull at a pulling speed of 50 ft. per minute. On level track and handling railroad cars in good condition, this machine should be able to pull a gross load of 250 to 300 tons.

From various tests in connection with their car pullers, Stephens-Adamson engineers have accepted the following figures as being conservative enough for average use:

On level track, 20 to 35-lb. rope pull is necessary to move each ton of gross weight (depending upon condition of rolling stock). Railroad cars are usually figured at 20 lb., and ordinary industrial cars are often allowed 35 or even 40 lb. per ton.

On inclined track the following formula can be used:

$$\left[\begin{matrix}\text{No. of tons}\\ \text{Gross weight}\end{matrix}\right] \times \left[\begin{matrix}\text{Normal pull}\\ \text{per ton on}\\ \text{level track}\end{matrix}\right] + \left(\begin{matrix}\%\text{ of}\\ \text{grade}\end{matrix} \times 2{,}000\right) = \begin{matrix}\text{Required}\\ \text{rope pull}\\ \text{in pounds}\end{matrix}$$

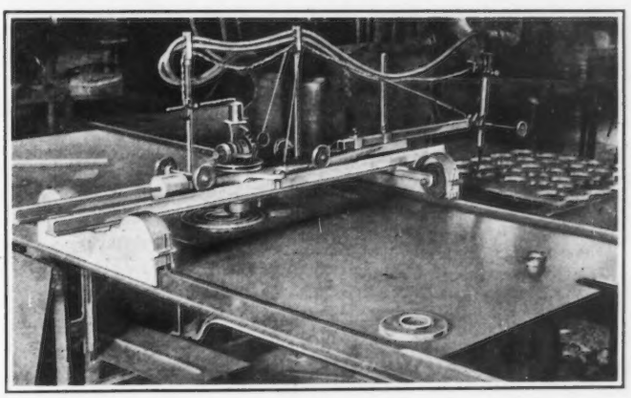
As an example, assume a railroad car of 75 tons' gross weight is to be pulled up a 3 per cent grade. Using the above formula a car puller must develop a rope pull of 6,000 lb. to move the load.

A Frictionless Bin Gate

A new gate for regulating the flow of material from overhead bins has also been announced by the Stephens-Adamson company. The inventor, R. W. Moore, seems to have eliminated with this device the friction encountered in the dragging the usual gate plate from under the tons of material resting upon it, according to the company. This device is shown in one of the accompanying illustrations. The Moore gate, as it is known, may be described as a compact belt conveyor, the frame of which can be moved back and forth under the bin opening. When the gate is closed, the wide belt completely closes the opening. It is operated by a hand wheel which rotates the head pulley. This, instead of pulling the belt, rolls the frame out from under the gate opening, allowing the material to discharge as this takes place. The gate is closed by turning the hand wheel in the other direction and rolling the belt back under the opening.

Something New in Welding

An automatic oxy-acetylene shape-cutting machine designed to cut shapes of any sort from steel plate, sheet, forgings, billets, or ingots is being introduced by the Linde Air Products Company, 30 East 42nd St., New York. This is illustrated in an adjoining cut. In it, the cutting blowpipe is mounted on a carriage which may be moved in any direction by an electric motor. For routine production it will operate automatically from templets. If only a few parts are to be cut out, a hand-tracing device can be attached and used to follow the outline of a sketch or blueprint. The manufacturer says that the parts of the machine are sturdily built without impairing the delicacy of adjustment necessary in a precision instrument of

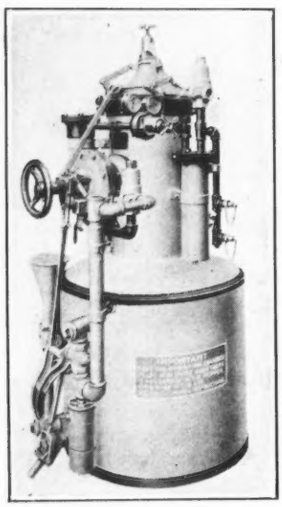


Automatic oxy-acetylene shape-cutting machine

this sort. Rigid construction, as well as the design, prevents lost motion and makes accurate cutting possible. Only one man is required to operate the machine. The parts are produced with straight corners and smooth faces, so that little machining is necessary for trimming. A cutting speed ranging from 3 to 20 in. per minute, depending on the thickness of the metal, is obtainable. Accurate and smooth cuts can be made in stocks up to 1 ft. and more in thickness. It is to be expected that the use of this machine will lower production costs.

Three New Acetylene Generators

For welding and cutting purposes, three acetylene generators of the medium pressure type have been introduced by the Oxweld Acetylene Company, of New York. One of these, the type MP-2, which is built in two sizes having 50 and 100-lb. carbide capacity



Medium pressure acetylene generator

respectively, replaces the earlier medium pressure generator. The type MP-3 generator, however, having over 300-lb. carbide capacity, is entirely new, inasmuch as no generator of the pressure type has ever before been made by this company in this size. These three generators are suitable for supplying welding and cutting blow pipes that use high or medium pressure.

Welding Used in Construction of Indicating Flow Meter

It is interesting to note that the Meriam Company, of Cleveland, Ohio, has introduced a new type of indicating flow meter, in the construction of which welding by the atomic hydrogen process is employed. This meter is suitable for measuring the flow of air, gas, saturated or superheated steam, oils and other liquids at any temperature, vacuum or pressure. Primarily, it is designed for high-line pressures, but with slight modifications it may be used with equally satisfactory results on vacuum or on low pressure, according to the manufacturer. It was decided to weld all pipe lines and valves in the meter connections, instead of using threaded unions, this because of the inaccuracy which would be caused in the readings by even the smallest leakage when dealing with high pressures. Through considerable experimenting, the method of atomic hydrogen welding was adopted. With this, not only is a perfectly smooth and non-porous weld obtained, but also extra grinding or finishing is made unnecessary. The operation of these meters depends upon the fact that the flow of the liquid or gas causes a loss of pressure along the pipe. To insure correct readings, an accurately proportioned orifice-disk is placed in the path of the flow in the pipe, and two small tubes are connected to the pipe line, one on each side of the disk. The difference in pressure between the two sides is recorded by the level of mercury or other non-evaporating liquid of constant weight. Since there are no gears and springs, accurate results are obtained over long periods, it is asserted. The disk, being of Monel metal, will not wear or corrode. It is obvious that the scales may be calibrated in cubic feet, barrels, pounds, gallons, or any other quantities per hour, as desired.

PATENTS

ARC WELDING MACHINE. No. 1,684,726. Sept. 18, 1928. Claude A. Bowlus, Birmingham, Mich.

DEWATERING APPARATUS. No. 1,685,085. Sept. 25, 1928. John T. Hoyt, assignor to United Filters Corporation, New York.

DRAFTING MACHINE. No. 1,684,993. Sept. 18, 1928. James Jolly, Bolton, England.

HOPPER CAR. No. 1,685,089. Sept. 25, 1928. Adolph Kassler, assignor to American Car & Foundry Company, New York.

PLACER MINING MACHINE. No. 1,684,869. Sept. 18, 1928. Ferdinand H. Krueger, Milwaukee.

VACUUM PUMP. No. 1,684,395. Sept. 18, 1928. C. H. Hapgood, assignor to The DeLaval Separator Company, New York.

CENTRIFUGAL CONCENTRATING AND AMALGAMATING APPARATUS OF THE VERTICAL TYPE. No. 1,684,870. Sept. 18, 1928. F. D. Lewis, Denver, Colo.

ION CONCENTRATION CONTROL. No. 1,684,645. Sept. 18, 1928. Irving B. Smith and Earl A. Keeler, assignors to Leeds & Northrup Company, Philadelphia.

POWER HAMMER. No. 1,685,447. Sept. 25, 1928. William W. Bieler, Hays, Kan.
This is a hammer for blacksmithing purposes.

ROCK DRILL. No. 1,684,638. Sept. 18, 1928. Ernest Penberthy, Redruth, Cornwall, England, assignor to the Climax Rock Drill & Engineering Works, Ltd., London.

SINTERING FINES OF EARTHY MINERALS. No. 1,684,958. Sept. 18, 1928. Reed W. Hyde, assignor to Dwight & Lloyd Metallurgical Company, New York.

WATER TREATMENT APPARATUS. No. 1,684,822. Sept. 18, 1928. Walter H. Green, assignor to General Zeolite Company, Chicago.

BORAX, RASORITE. No. 1,685,214. Sept. 25, 1928. Thomas M. Cramer, assignor to Pacific Coast Borax Company.
A method of producing commercial borax from rasorite by a wet process.

ELECTRIC BLASTING. No. 1,685,382. Sept. 25, 1928. Joseph Stuart, 2d, assignor to Hercules Powder Company, Wilmington, Del.
A method of bridging the connecting wires of electric blasting caps.

RECOVERING SULPHUR DIOXIDE. No. 1,685,754. Sept. 25, 1928. G. A. Richter, assignor to Brown Company, Berlin, N. H.
This patent covers a method of recovering sulphur dioxide from waste gases.

SURVEYING BORE HOLES. No. 1,684,337. Sept. 11, 1928. L. B. Wright, A. B. Yates, and A. A. Lease, Lead., S. D.
The instrument covered by this patent is described in an article which appeared in "Engineering and Mining Journal" of July 14, 1928.

FLOTATION. No. 1,684,536. Sept. 18, 1928. A. H. Fischer, assignor to Guggenheim Brothers, New York.
This patent covers an improvement which comprises the floating of the mineral in the presence of a water-repellent reaction product resulting from the reaction between a metal xanthate and an organic acid chloride.

ORE CONCENTRATION. No. 1,685,644. Sept. 25, 1928. M. M. Newton, Cragmor, Colo.
This covers a rectangular concentrating table which receives its feed at the central point of the surface and discharges to either of the two parallel sides. Each end of the table is provided with two sets of diagonally opposed riffles.

FLOTATION. No. 1,683,724. Sept. 11, 1928. Adolphe H. Ney, New York.
This covers a method of subjecting alkaline pulp to froth flotation in the presence of the products of reaction of an excess of disulphurdichloride upon aromatic amino compounds having at least one ortho-position to the amino group free or unsubstituted, to use the language of the "Patent Gazette."

SEPARATION OF MATERIALS OF DIFFERENT SPECIFIC GRAVITIES. No. 1,685,521. Sept. 25, 1928. Thomas M. Chance, Merion, Pa.
A method of separating the said materials involving their immersion in a fluid mass consisting of an agitated mixture of liquid and fine solids heavier than the liquid and substantially soluble and having a specific gravity between that of the lighter and heavier of the materials and other features.

BLAST-FURNACE. No. 1,685,208. Sept. 25, 1928. F. H. Willcox, assignor to Freyn Engineering Company, Chicago.
This covers a type of construction comprising a bell supporting frame carried by the furnace structure, a skip incline supported independently of the furnace, and idler pulleys carried by the incline and coacting with the cables operating the bell whereby their lateral thrust is received by the incline structure.

ORE SEPARATOR. No. 1,685,466. Sept. 25, 1928. E. H. Stepp, Knoxville, Tenn.
A centrifugal ore separator comprising a bowl having an amalgam-retaining trough on its inner wall and an inner rotary member provided with a means on its exterior surface for lifting the concentrate and water so as to retard its downflow and at the same time throwing it outwardly to bring the heavier mineral content into contact with the amalgam.

NEWS OF THE WEEK

Summary

GENERAL increases in miners' wages are reported by copper producers in Arizona, Montana, Utah, and Nevada. Advances, which result from the higher prices being obtained for copper, average about 10 per cent higher than the previous wages. Page 547.

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Strenuous objection to amendment of the complaint filed against it in 1925 by the Federal Trade Commission has been made by the Aluminum Company of America. The company claims that the amendment makes the complaint virtually a new document. Page 548.

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The meeting of lead producers in London found that at present production of lead is sufficient for demand, with the exception of that in the United States, where domestic consumption is larger than the mine output. Page 550.

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The Hollinger mill, at Timmins, Ont., is now treating about 5,000 tons daily. Ore reserves are being depleted, and costs are increasing as the result of an extensive development campaign at the mine. Page 550.

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Oliver Iron was given the verdict in a suit filed against it for damages resulting from blasting by the company at its Hibbing mines. This suit was regarded as a test case for many similar actions. Page 549.

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Mining men in Colorado are protesting the proposed abandonment of the Watertown-Leadville railroad, which serves the mines in Park and Summit counties. Page 549.

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Hecla Mining has ordered two new hoists and equipment, to cost about $300,000, for the main shaft at its mine in the Coeur d'Alene district of Idaho. Page 546.

Murdoch Announces Plans for New Shaft and Smelter Expansion at Noranda

President of Rouyn Company Issues Statement on Property—"H" Orebody Narrowing Below 975 Level, but Formations Are Favorable for New Discoveries, He Declares

NORANDA Mines will sink a shaft north of the No. 3, the present main shaft, and will gradually increase the capacity of its smelter, bringing the second unit into production in 1929, according to an announcement by James Y. Murdoch, president of the company, after a trip to the property, in the Rouyn district of Quebec. The new shaft will be sunk to a depth of about 1,000 ft. and will be connected at that point with the No. 3 shaft. In regard to diamond drilling on the "H" orebody, the discovery of which on the 975 level sent the value of Noranda stock soaring, President Murdoch said that although results cannot be said to be conclusive, they indicate that the orebody becomes smaller below this level. However, as there is no change in formation, he believes that there is a possibility of finding ore at greater depths than those reached by the drills. Parts of the statement follow:

"The fact that the first unit of the smelter has shown that it is probably capable of handling double the original estimated capacity (500 tons) has brought up many problems to be met with before the second unit can be put into operation. . . . In addition to preparing the mine for the production of the necessary tonnage to supply the two units, practically every unit of the smelter must be added to, right through from the crusher equipment to the converters. The work of sinking the new shaft and putting in the necessary hoist and additional crushing equipment and performing the underground work necessary to make the shaft of use will possibly take a year to complete.

"In addition, the capacity of the roaster section must be increased, the construction of the second reverberatory furnace must be completed, an addition will have to be built to the converter building, and additional converters installed.

"Work on the 500-ton concentrator is progressing, and it is hoped that it will be brought into operation some time early in November. For several months it will probably work at only partial capacity on custom ore from Waite-Ackerman-Montgomery."

Development of the "H" orebody has been undertaken on the 600, 725, 850, and 975 levels. At all of these points, the orebody was encountered within a few feet of the No. 3 shaft. Crosscuts were driven to the north and all faces were still in ore when work was stopped. At the 975 level, diamond drilling was done both vertically and horizontally. Much more work will have to be done, however, before a definite estimate can be made as to width, depth, and length. Fairly good results have also been obtained from development of the "B" and "K" orebodies.

A description of the Noranda, or Horne, mine by A. H. Hubbell, associate editor of *Engineering and Mining Journal*, appeared in the issue of Sept. 1 and a description of the smelter, also by Mr. Hubbell, in the issues of Sept. 15 and 22.

Water at Old Dominion Is Hindering Operations

OPERATIONS at the Old Dominion mine, in Globe, Ariz., have been greatly handicapped lately as a result of the flooding of the 2,600 level. The three main feeders which carried the current to the pumps on this level burned out, and it was necessary to pull the pumps. An 8-in. air lift was installed in place of the pumps, and by this means the water level is being held at a point 20 ft. below the 2,400 level. Water is being pumped from this part of the mine at the rate of 2,000 g.p.m. A 12-in. air lift is now being installed to unwater the shaft, and three new pumps, having a capacity of 1,000 g.p.m. each, are being installed on the 2,400 level. The amount of water pumped from the entire mine amounts to 5,000,000 g.p.d. A large amount of this is purchased by Miami Copper for use at its mill, 7 miles away.

During the summer a crosscut on the 2,400 level cut a 35-ft. vein of 2.9 per cent ore. Another crosscut is now being driven across the same vein, 125 ft. farther west. On the 2,600 level the crosscut to the vein had been driven 700 ft. south from the A shaft when the level was flooded. A small vein of 3 per cent ore was encountered in this crosscut, but has not yet been explored.

Most Old Members of Tri-State Association Renew

PRACTICALLY all of the old members of the Tri-State Zinc & Lead Ore Producers' Association have signed up for an additional five-year period, and it seems as if a large number of the non-members in the Tri-State district would agree to join a rejuvenated and reorganized association. At a recent meeting of the board of directors an invitation was made to all producers of zinc and lead in the district to join the association and participate in its reorganization.

As originally constituted, producers with smelter connections were barred from the association's roster. About a year ago, however, a more liberal policy toward membership and the cost of membership was sought by some of the directors. The two major demands of non-members were for lowering the dues, which at present are 20c. a ton for each ton of concentrates produced, and abrogation of membership restrictions. At the time nothing came of these demands, but as the directors have recently consented to a reduction of dues to a maximum of 15c., and preferably 10c., a ton of concentrates, and the bars have been lifted in regard to membership requirements, it seems that expansion of the scope of the association is in order. The annual meeting will probably be held Oct. 15.

Engineers Form Hoover Committee in Washington

A DISTRICT OF COLUMBIA section of the Hoover-for-President Engineers' National Committee has just been organized; and members of that profession residing in Washington, most of whom have the right to vote in their home districts, are being urged to support the Republican nominee because "the problems which lie immediately before our country are for the most part charged with engineering, and the opportunity of having an engineering mind to direct their solution will be a fortuitous circumstance in our national development, outweighing all other considerations."

Henry C. Morris, a mining engineer who was with the Fuel Administration during the war, and later chief of the fuel division of the Department of Commerce, has been chosen as chairman of the local committee. John Hays Hammond, internationally known mining engineer, has accepted the position of honorary chairman. Headquarters have been opened in the Transportation Building. Prominent members of the Washington Society of Engineers, the American Institute of Electrical Engineers, the American Institute of Mechanical Engineers, and similar professional bodies are included on the local committee. Cabot Stevens, hydroelectrical engineer, who was assistant manager of transportation of the United States Housing Corporation, is secretary; with Edwin C. Wendt, consulting engineer, as treasurer.

John Hays Hammond, in accepting the honorary chairmanship, said:

"It is a reason for the justifiable pride of the mining profession that one of the great political parties has, in response to irresistible popular demand, nominated as its standard bearer a distinguished member of that profession. His training and experience as an engineer, no less than his admirable character and transcendent ability, have enabled Herbert Hoover successfully to carry out the great humanitarian work that has made him one of the world's most notable benefactors. In his new field of opportunity, for we feel sure of his election to the Presidency, Herbert Hoover, engineer, philanthropist, statesman, will continue to render, and in a degree even more notable, service to his country and to humanity."

Other members of the committee are Albert L. Baldwin, J. Rowland Bibbins, L. D. Bliss, Ovid M. Butler, William Malcolm Corse, Roy W. Crum, Robert W. Dalgleish, John H. Finney, John M. Gries, Charles B. Hawley, Arthur B. Heaton, Amasa M. Holcombe, Harrison E. Howe, Edward E. Hunt, Vernon L. Kellogg, A. B. McDaniel, Theodore W. Newburn, F. H. Newell, A. C. Oliphant, Charles L. Parsons, Donald H. Sawyer, Edwin E. Slosson, C. B. Strickler, F. M. Surface, Charles H. Tompkins, C. M. Upham, L. W. Wallace, Daniel C. Walser, and Harvey W. Wiley.

Pacific Mining's Plane Suffers Second Accident

THE airplane with which Pacific Mining had intended to establish a regular airline from Guadalajara, State of Jalisco, to Mexico City, has met with its second accident. The plane was damaged in landing at Guanuchil, State of Sinaloa, on its way to Guadalajara from Nogales, Ariz. Wilford Deming was the pilot. The first accident happened when the plane landed at the Nogales airport, a wing being damaged.

Charles H. McKinnis, president of Pacific Mining, a Spokane company, had planned to carry the gold bullion from the Mezquital del Oro mine of the company, near Guadalajara, to Mexico City in the plane, and to make the return trip with the mine payroll.

May Reopen Mother Lode Mine

Reports are current that the Bunker Hill mine, on the Mother Lode, near Amador City, Calif., is to be unwatered and operated. The mine is equipped with hoist, shops, and a 40-stamp mill, and was closed down some years ago as a result of high costs.

Hecla Mining Orders Two New Electrical Hoists

HECLA MINING, silver-lead producer in the Coeur d'Alene district of Idaho, has ordered two new electric hoists, to be delivered within six months, from the Nordberg Manufacturing Company, of Milwaukee, Wis., according to an announcement by James F. McCarthy, president and general manager of the Hecla company. Electrical equipment for the hoists, which will serve the main Hecla shaft, now being deepened to 3,200 ft., will be furnished by Allis-Chalmers Manufacturing. The total value of this new hoisting equipment is estimated to be $300,000.

Specifications for the main hoist require a lifting power of 14,000 lb. net at a rope speed of 2,400 ft. a minute. The supplementary hoist will lift 8,000 lb. and have a rope speed of 1,350 ft. a minute. The Hecla shaft serves not only the Hecla mine, but is also used for hoisting ore from the Sullivan mine, owned jointly by Hecla and Bunker Hill & Sullivan, from which a large part of the zinc output to be handled by the new electrolytic zinc plant of Sullivan Mining will be obtained.

Tintic Standard May Connect Iron Blossom and Colorado

AS THE result of the suspension of the Eureka Hill railroad, thus removing surface transportation for ore from its Iron Blossom mine, Tintic Standard may connect the underground workings of the Iron Blossom and Colorado properties in the Tintic district of Utah. The Colorado shaft is in the north end of the mineral tract recently obtained by Tintic Standard from Knight Investment, and is adjacent to the loading station of the Rio Grande railway. The No. 1 shaft of the Iron Blossom is at the extreme south end of the tract and is about one and a half miles distant from the Colorado shaft.

About 1,800 ft. of drilling will be necessary to connect the present workings of the two mines on the 1,900 level of the Colorado mine. Ore from the Iron Blossom could then be trammed to the Colorado shaft, hoisted, and shipped at the Rio Grande station. Besides providing a means of transportation for the ore, the connection between the two mines might possibly open up new ore deposits in the undeveloped territory.

East Butte Cutting Station at 2,600 Level

East Butte Copper is cutting a station at the 2,600 level of the Pittsmont mine, in the Butte district of Montana. About a year ago, according to Robert H. Gross, president of the company, it was decided to sink the shaft from the 2,400 level to the 2,600 level to determine whether the orebodies found on the 2,400 level increased in value with depth. The shaft reached 2,600 ft. on Sept. 1 and the work of cutting a station was started.

Labor Benefits From the Better Copper Price

GENERAL increases in the daily wages paid in most of the important copper-mining districts of the United States are reported. The general advance is about 10 per cent over wages paid prior to Oct. 1, when the new scales go into effect. These increases are undoubtedly due to the advance in the price for the metal, which is now selling at 15.25c. Among the companies that have announced increases are:

Phelps Dodge Corporation, at its operations in the Bisbee and Morenci districts of Arizona.

Calumet & Arizona, in the Bisbee district, and its subsidiary, New Cornelia, at Ajo, Ariz.

Shattuck Denn, in the Bisbee district.

Anaconda Copper Mining, at its operations at Butte, Great Falls, and Anaconda, Mont.

Utah Copper, in the Bingham district of Utah.

Nevada Consolidated, at its Nevada mine near Ely, Nev.; the Chino mine, in New Mexico; and the Ray mine in Arizona.

Statements in the Eastern papers have indicated that wage increases would be obligatory when copper reached 15c., as a result of sliding scale agreements with the miners. Some such agreements existed many years ago, and still do with respect to lead prices in certain districts, but the increased wages of copper miners have been entirely voluntary on the part of the producers, though there would have been considerable disappointment among the wage-earners had they not been granted.

These advances include all mine, mill, and smelter employees. The following announcement was made by Anaconda Copper Mining in connection with the increase:

"Effective as of Oct. 1, 1928, and until further notice, the wage of all employees upon the daily payroll will be advanced 50c. a day over the present scale. Miners' contract prices will be adjusted proportionately. The above increase shall remain effective as long as the domestic price of electrolytic copper, as quoted by *Engineering and Mining Journal*, shall average 15c. a pound or more for the calendar month. In the event that the price of electrolytic copper, as above specified, averages less than 15c. a pound for a full calendar month, the scale will, effective the first of the following month, be reduced by a like amount of 50c. per day.

"This announcement applies to the Butte mines and to the smelters and refineries of the Anaconda company at Anaconda and Great Falls."

Other operators in the district have agreed to the scale specified in the foregoing, which makes miners' wages $5.25 a day.

Sherritt-Gordon Not to Pay Royalties for Twenty Years

SHERRITT-GORDON, the copper-lead-zinc property in the Cold Lake district of northern Manitoba, is exempt from payment of royalties to the Canadian government for a period of twenty years, and will be permitted to export its blister copper for final treatment. These concessions were made on the recommendation of Charles Stewart, Minister of the Interior, who pointed out that transportation of the copper to the Pacific Coast plants for refining and then shipment to the Eastern market would make the enterprise, which will depend for its success on low-grade ore and large-scale methods, unprofitable. The Dominion Lands Act, which was set aside in this case, requires that all ores produced on lands leased from the Canadian government be treated within the dominion.

United Verde Is Building New Homes at Jerome

United Verde Copper has let a contract to the T. B. Stewart Construction Company, of Phoenix, Ariz., for the construction of nine new houses which are to be built at Jerome, Ariz., at the elevation of the 300 level in the mine. These will be finished by November. Contracts for the construction of ten homes at the 500 level elevation will be let later. Ten additional homes will be built at Clarkdale. A Mexican patio will be built at Hopewell and one at Clarkdale. When the building program is completed 40 houses will have been built at the 500 level and 29 at the 300 level. Work is also about to be started on the construction of a $29,000 club house for the company's employees in the Jerome district.

Kearsarge Standard Merges With Ophir Bullion

AT A recent meeting of stockholders of Kearsarge Standard Mining, which operates a silver-lead property in the Ophir district of Utah, 60 miles south of Salt Lake City, consolidation of the company with Ophir Bullion, another property in the same district, was authorized. The new company will be known as Kearsarge Standard. Stockholders in Ophir Bullion have been given stock in Kearsarge Standard on a share-for-share basis. As a result of the consolidation, Kearsarge Standard now controls all of Shoo Fly Hill.

The ore bins which Kearsarge Standard has been building have been completed and regular shipments of seven to ten tons of ore a day are being made to the smelter. A boarding house for the employees is being completed.

Calumet & Hecla to Reopen No. 17 Shaft on Osceola Lode

AS SOON as an adequate force is available, Calumet & Hecla Consolidated will reopen the No. 17 shaft on the Osceola lode. This means that there will be five operating shafts on this vein. Yield of refined copper per ton of rock from this amygdaloid branch of the company is about 20 lb., as compared with not quite 16 lb. in 1920, just before Osceola lode shafts were shut down. Adoption of the Fahrenwald flotation methods will increase yield more than 2 lb. per ton, it is expected.

In the conglomerate lode, some of the company's shafts have a life of twenty years or more, above the 81 level. Below that level, mining operations will be carried on through two connecting shafts, to reduce expenses. In No. 9 shaft, South Hecla, operations are proceeding upward with the removal of backs of stopes, arches, and pillars. This work is now bottomed on the 55 level. A daily production of about 560 tons of comparatively high-grade ore, averaging 60 lb. per ton, is coming from these operations. In Nos. 6 and 7 shafts, South Hecla, stripping operations from the bottom upward have been started only recently.

The labor situation of the company is showing improvement. A total of 5,258 men are employed by Calumet & Hecla now, compared with 4,270 a year ago. Labor is steadier than at any time since the World War.

The company's conglomerate tailings, which are being re-treated in two reclamation plants, have yielded 187,392,000 lb. of refined copper up to the first of this year. The deposits originally contained 40,000,000 tons of recoverable sand—30,000,000 in the Calumet deposit and 10,000,000 in the Tamarack. Up to 1928, a total of 18,150,000 tons had been re-treated, returning 10.32 lb. of copper per ton. In 1927, the average cost sold was 6.23c. per pound. Approximately 22,000,000 tons of sand remains to be treated, or a seven to eight years' supply at the present rate of reclamation.

New Tunnel at Basin Montana Strikes Main Vein

Recently a new tunnel was driven on the Grey Eagle-Comet vein, at the property of Basin Montana Tunnel, in Jefferson County, Mont., at a point about 400 ft. west of the explored territory. This new tunnel is now in 171 ft. At the 150 ft. point, the vein was cut, showing a width of 45 ft., with a large amount of ore in the center of the vein and on the footwall side, about 20 ft. below the surface. The vein will be drifted on until it connects with the old workings. The drift will be about 230 ft. long, and will be entirely in virgin ground. The old tunnel on the Grey Eagle claim has been opened for 400 ft. At that point, streaks of silica have been found parallel to the main vein.

Railroad to Abana Will Not Be Built This Year

C. T. YOUNG, superintendent of development for Canadian National Railways, has recently made an inspection of the Abana property in northwestern Quebec, with a view to determining whether or not a branch railroad should be built to the property. His advice is that the present wagon road should be repaired and made to do for another year. This is taken as meaning that in his opinion another year's development work should be done on the property before the matter is again brought up.

Abana has been the subject of a great deal of controversy, and much talk has been heard about the necessity for a railroad. Reports have placed the ore reserves at a gross value of $30,000,000, but it is believed that these estimates are based largely on an insufficient number of diamond-drill holes, with a limited amount of development on the 300 level. Practically all of the machinery for a small concentrator is on the ground, and it will probably be erected this winter.

Tailings Suit Started Against Colorado Lead-Zinc

Colorado Lead-Zinc, operating in the Leadville district, has been cited to appear in the district court of Chaffee County, Colo., on a charge of polluting the water in the Arkansas River. Acids from its 200-ton mill in California Gulch find an outlet in the river. It is probable that an artificial lake for the tailings will be built to settle the case.

A.S.&.R. Ore to Be Treated at American Zinc Plant

A contract has been made whereby certain zinc ores of American Smelting & Refining will be treated at the East St. Louis plant of the American Zinc Company, of Illinois, controlled by American Zinc, Lead & Smelting. The contract goes into effect immediately. The smelter at East St. Louis has an annual capacity of 54,000 tons of zinc concentrate.

Foundation Organized for Colorado School of Mines

For the greater honor, glory and growth of the Colorado School of Mines, the Colorado School of Mines Foundation, a non-profit organization has been formed, by Charles M. Rath, C. Lorimer Colburn, C. Clarence Malmstrom, of Denver and Edward P. Arthur, of Cripple Creek. Five directors have been selected to receive gifts, bequests, endowments, endowed professorships, and funds for additional buildings. They are M. F. Coolbaugh, president of the school; Jesse F. McDonald, Max W. Ball, William H. Smiley, and William B. Waltman.

Aluminum Company Objects to New Amendment of Complaint by Federal Trade Commission

By Paul Wooton
Special Washington Correspondent

STRENUOUS objection to amendment of the complaint filed against it in 1925 by the Federal Trade Commission has been made by the Aluminum Company of America. The Aluminum Company takes the position that after having had the case under consideration for three years, during which hearings, totaling 41 days, were held, the commission proposes to bring what amounts to a new case against it. The company points out that during the hearings a large amount of testimony was taken over the objection that it did not come within the scope of the complaint. Attorneys for the company believe the commission realizes that its first case has fallen down and that an effort is being made to bring a new case in the form of amendments to the old case. It also is alleged that the amendments seek to bring before the commission private litigation now pending in the courts. The amendments complained of are summed up as follows:

That the company is endeavoring to monopolize bauxite by purchasing all bauxite deposits that could be used by competitors for the manufacture of aluminum.

That the company is seeking to monopolize water power by purchasing all water power which might be used by others in competition with the company.

That the company has sought to restrain competition by representing that it controls the market for both foreign and domestic aluminum.

That the company controls the market for foreign aluminum within the United States, thereby restricting substantial competition in foreign aluminum within the United States.

That the company transfers virgin aluminum metal to its subsidiaries below the cost of production or below the selling price of the metal to competitors engaged in the manufacture of aluminum alloy sheets.

That the company sells aluminum alloy products at prices less than cost or less than competing producers can sell the same at a profit.

La Joya Quicksilver Plant Will Be Ready Nov. 1

According to Joseph Garcia, superintendent of the La Joya quicksilver mine, in Napa County, Calif., the new 40-ton plant will be in operation by Nov. 1. Foundations and power plant have already been completed. Present ore reserves are estimated at 40,000 tons above the 300 level. An orebody in the north of the property is being explored. The mine is operated by Acme Mines.

Highland Shaft Down 465 Ft.

Sinking of the Highland shaft of the Ardsley Butte Mines Corporation, in the Butte district, has reached the 465 level, where work has been temporarily stopped. It is believed that this shaft will be sunk an additional 135 ft. in the near future. Very few shipments have been made recently, because of the development work. The main drift on the 365 level has been driven 820 ft. west of the shaft, where the face is now in ore. About 11 ft. of high-grade silver ore has been opened up.

Reopen Virginia Gold Mine

The Whitehall mine, in Spottsylvania County, Va., is being reopened by T. B. Iles, of Washington, D. C. A new shaft has been started and a pilot mill is completed. This is the best-known gold mine in Virginia. U. S. Mint records show that, prior to the Civil War, more than $1,800,000 was produced from a depth of less than 30 ft.

Lake Shore Will Use Hoist on 1,000 Level of New Shaft

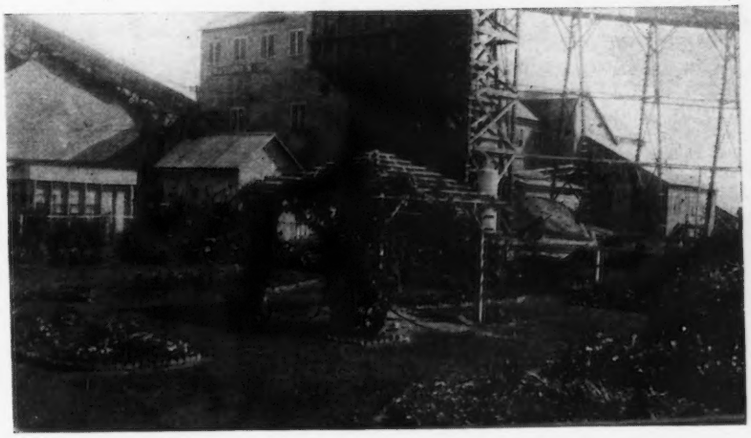
A hoist for sinking purposes is being installed on the 1,000 level of the new shaft of Lake Shore Mines, in the Kirkland Lake district of Ontario. The present objective of the shaft is 2,000 ft., but it is intended eventually to continue it to greater depths. A large crusher of the cone type, capable of handling 150 tons an hour, has been installed on the surface, and a jaw crusher has been placed on the 1,400 level. It is reported that development on the lower levels is satisfactory, excellent widths being found on the 1,600 level. The Lake Shore mill is handling 1,000 tons a day.

Reno Mine Acquired by British

British interests represented by Captain Charles E. Hutton have acquired the property of Reno Gold Mines, in the Sheep Creek district of West Kootenay, B. C., Canada. Captain Hutton, who is a director of Woodbine Gold Mining, made an initial payment of $30,000 on the property on Sept. 21. The Reno mine has been developed by four tunnels.

Gold Dredge Shipped to Japan

Yuba Manufacturing Company shipped a 10 cu.ft. bucket gold dredge recently to the Mitsubishi Company, of Japan, for operation on its properties in Chosen.



The prize-winning garden, with the Oklahoma Woodchuck plant in the background

Annual Flower-Garden Contest in Tri-State District Won by Interstate Zinc & Lead

THE interest in matters botanical displayed by the miners in the Tri-State district is noteworthy. In spring the district which annually produces more zinc than any equal area in the world devotes a goodly part of its attention to the collection and marketing of strawberries, as has previously been reported in *Engineering and Mining Journal*. Now our local correspondent describes the results of the annual flower-garden contest, an institution of three years' standing in the district.

For sedulous interest in the appearance, upbringing, and conduct of the tender young buds entrusted to his care, Benjamin Fields, of the Oklahoma Woodchuck mine of Interstate Zinc & Lead, has been rewarded with the first prize of $50. The horticultural exhibit assiduously nurtured by O. T. Jones, of the Blue Goose mine of Commerce Mining & Royalty, was awarded second prize of $30. Inasmuch as last year the positions were reversed, with the Blue Goose entry winning first and the Oklahoma Woodchuck garden second, it would seem that the judges are extremely vacillating individuals. Other awards were made to Fred Carpenter, Consolidated Lead & Zinc, $20; J. J. Thomas, Evans-Wallower Lead, $15; T. M. Mix, Lion mine of Velie Mines, $10; and Ed Endicott, Gordon mine of Federal Mining & Smelting, $5.

Oliver Iron Wins in Suit for Damages from Blasting

AFTER deliberation by the jury for five hours, Oliver Iron Mining was given the verdict in the suit filed against it by Mrs. Anna Jarvi, of Hibbing, Minn., for damages resulting from blasting by the company at its mines near Hibbing, Mrs. Jarvi claimed that the operations in the "North Forty" section of Hibbing made her residence and business buildings uninhabitable and had caused severe injuries to members of her family. She asserted that pieces of rock and ore hurled through the air by blasting had alighted on her buildings, causing heavy damage. The suit was for $28,900 damages.

Many similar damage suits by owners of Hibbing real estate rested on the outcome of this suit, it is reported. The trial lasted seven days and was transferred from Hibbing to Virginia on appeal of the defendant that a fair trial could not be secured in Hibbing. Judge Kenny, of Duluth, presided.

Manganese Ore Will Build Mill in Tennessee

The Manganese Ore Company, of Watauga Valley, Tenn., has purchased several manganese properties in Carter County, Tenn. The company will erect a mill at a central point to handle the ore from all its mines. This is regarded as a significant start in the development of manganese in this district.

New El Paso Ships Ore

New El Paso Mines, in the Cripple Creek district of Colorado, has shipped six carloads of ore from the strike recently made on its property. The returns averaged from $26 to $32 a ton. Reports from the property state that the strike, which was made on the surface, is widening with development. Total shipments from the Cripple Creek district during August had a gross value of about $350,000. This was the highest amount during the year.

Mining Men Protest Move to Abandon Platte Canyon Line

PERMISSION to abandon the entire Platte Canyon line, which connects Watertown and Leadville, Colo., has been asked of the Interstate Commerce Commission by the Colorado & Southern Railroad. Mining men in Park and Summit counties, who would be seriously affected by such a move, have made a protest against the abandonment and the Colorado Mining Association has taken official action by filing its protest with the commission.

The railroad, in presenting its request, claims that it is losing $350,000 yearly on the line. In some circles, however, it is believed that this request is made as a result of the demand on the part of the Denver Water Commission for the right-of-way from Watertown to Buffalo, one of the narrowest parts of Platte Canyon.

Included among the mining properties which would be affected by the abandonment of this line are the Climax Molybdenum Company's mines near Kokomo, the entire Breckenridge district in Summit County, and the London gold mine, in Park County. The molybdenum mines at Climax are the largest known deposits of the metal.

Sunshine Nets $23,320 From One Carload of Concentrate

A SINGLE carload of concentrate shipped from Sunshine Mining to the Bunker Hill & Sullivan smelter is said to be the richest shipment ever made by any mine in the Coeur d'Alene district of Idaho. The shipment totaled 48.517 tons, and its metal content averaged 844.5 oz. of silver, 32.35 per cent lead, and 10.4 per cent copper per ton. The net return to the company was $23,320.67. The company is operating a flotation mill of 150 tons' capacity, and is shipping an average of four carloads of concentrate a month. Most of the Coeur d'Alene mines are chiefly lead, with silver produced as a byproduct. The Sunshine ore, however, has a relatively high silver content, and lead is produced as the byproduct. The Sunshine vein is comparatively narrow, the pay streak varying from a few inches to 3 ft. in thickness.

After being operated for several years by leasers, who managed to make good pay until the ore in the upper workings was exhausted, the property was taken over by a group of Yakima (Wash.) men and Sunshine Mining organized, with John Sawbridge, of Yakima, as president. This company, after a large outlay, despite several discouraging developments, succeeded in placing the mine on a paying basis, and for the last year and a half has been paying dividends at the rate of 2c. per share every two months on its outstanding stock of 1,500,000 shares. C. C. Samuels is now general manager, having taken charge of operations about two years ago.

London Letter

By W. A. Doman
Special Correspondent

Lead Producers Find World Consumption of the Metal Equal to Output

London, Sept. 18, 1928.—The conference of lead producers which opened in London yesterday held another meeting today, at which, I understand, the preparation of statistical information of world production and consumption, the prevalent position of stocks and production, and the steps that may be necessary to regulate production to meet any slackening in demand were all considered. An official notice, issued after the meeting, stated that the position of world stocks was surveyed and that they were found to be inconsiderable. Arrangements were made to provide against any addition to present production and, in the event of urgent necessity, to curtail it. It was generally felt that consumption is now keeping pace with the world's recently reduced production and that there is no need for immediate action to further reduce it.

A corollary to the official statement adds the very important notice that "the domestic production of the United States, being insufficient for the country's needs, is not affected by the resolutions arrived at."

THE report of New Modderfontein for the year ended June 30 has reached London, and shares have weakened considerably on the figures therein disclosed, which, although establishing new records for tonnage mined and milled, gold recovered, working revenue and profit for the year, show clearly that the Main Reef Leader development is quickly coming to an end. The hopes entertained that this great mine would be able to circumvent and postpone its natural end by developing tonnages from the parallel Upper Leaders and the South Reef are less sanguine as a result of the figures now disclosed, and it is seen that as against 2,113,416 tons mined averaging 8.5 dwt., only 1,361,100 tons was developed, although the grade was higher at 9.2 dwt. per ton. As "comparatively little work will remain to be done after the current year to complete the major development program on the Main Reef Leader," and as this reef yielded 958,600 tons of the total ore developed during the year, the prospects of effectively continuing operations by working the other reefs after the Main Reef Leader is exhausted have become considerably diminished. Present reserves, at 9,157,000 tons, of 8.7-dwt. grade, provide for less than five years' operations at the present rate; and, with the small tonnages being developed in the other reefs, which are of much smaller average width and therefore more difficult to mine, it is believed that the end is within sight.

The British & South Pacific Trading Company, Ltd., a member firm of the recently formed £10,000 Chilean Nitrate of Soda Distributors, Ltd., is increasing its capital from £300,000 to £1,000,000 by the creation of 700,000 new £1 shares. It has not been decided how much of the new capital will be issued in the immediate future, but the total increase is to enable the acquisition on favorable terms of a further interest in nitrate-producing companies, and to provide for the company's requirements for a considerable time ahead. Meanwhile, interest in the future of Chilean nitrate is maintained at a high pitch.

Mexico City Letter

By W. L. Vail
Special Correspondent

More Activity in Mining in Mexico During First Part of 1928

Mexico City, Sept. 25, 1928.—The report given out by the mining division of the Mexican Department of Commerce, Labor and Industry on conditions during the first half of 1928 states that there was a healthy increase in applications for exploration and working concessions—1,292 applications compared with 973 applications during the same period of 1927. Among the important activities during this period mentioned by the department are the opening of the 300-ton mill by the Peñoles company at its Suriana property, in the State of Guerrero; the 150-ton plant at Xitinga, in the same state, put into operation by Chontalpan y Anexas; a 50-ton mill installed by the Montecarlo company, also in Guerrero; a 25-ton oven for treating quicksilver at Huahuaxtla, Morelos, and the opening of a 300-ton flotation mill by Santiago Mining in the same state. The government anticipates even a better showing for the last six months of the present year.

THE NEW lead smelter situated at Mazatlan has been blown in by the Compañia Mexicana de Minerales, which is controlled by Belgian interests. Ths plant, which has a capacity of 100 tons of ore a day, was built at an expense of about $300,000. Work was started early in the spring of the year.

Completion of the Kansas City, Mexico & Orient Railroad to the Rio Grande, at Ojinaga, has tended to increase mining activities among small operators in northeastern Chihuahua, particularly in the districts of Sierra de las Damas and Los Lamentos. The former camp is now only 35 miles from the station of Encantada. Operations were begun in this district about three years ago, but because of its isolation and lack of water, very little has been done beyond superficial exploration. Ores contain lead and silver. Eight properties are now being operated.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Hollinger Mill Now Treating 5,000 Tons—Ore Reserves Said to Be Low

Toronto Ont., Sept. 29, 1928.—The bad news on Hollinger Consolidated would appear to be all out, following a recent interview with the president of the company, N. A. Timmins, who is quoted as saying that costs at the property in the Porcupine district are up and that ore reserves are low. At present a very aggressive development campaign is being carried on and this is reflected in the costs, which, including 20c. for the fire disaster, are now about $4.45 a ton. The mill is handling about 5,000 tons of gold ore a day, with the grade averaging about $6.20 a ton. Ore reserves, which dropped from $66,000,000 to $60,000,000 during 1927, are expected to show a further decrease of from 25 to 30 per cent. This would indicate a decrease of considerably more than the year's production. It is believed that conditions in the future will improve rather than grow worse, and there is no uneasiness expressed regarding the ability of the mine to earn the present rate of dividend for many years. Crosscutting from the 3,900 level of the Schumacher shaft has been started.

DIRECTORS of Amulet Mines of Quebec have issued a supplementary statement covering operations from July 1 to Sept. 22. This deals with important recent developments, which have considerably enhanced the tonnage and value of the estimated ore reserves. Work on the 150 level has disclosed extensions of both C and D orebodies that average considerably higher than the rest of the mine. The directors have decided to start the immediate construction of a concentrator with an initial capacity of 200 tons a day. The crushing plant will have a capacity of 400 tons to provide for any desired increase. Mill plans are almost completed and contracts will be let within a few weeks. Decision to construct a tramway to connect the concentrator with the railroad has also been made. The cost of the concentrator is estimated at $200,000 and that of the tramway at $40,000.

Hudson Bay Mining & Smelting, owner of the Flin Flon mine, will pay a bonus of $250,000 for completion of the branch railroad from The Pas to the mine ahead of the schedule, which called for completion by the first of the year. The railroad is 90 miles long. It was started in March and finished on Sept. 21. The government of the Province of Manitoba has agreed to meet deficits, up to $100,000 a year, in the operation of the railroad for the next five years.

Prize-Winning First-Aid Group Reflects Distinction on the Mining Industry

Photo by Heyn Keeley, Great Falls, Mont.

Zinc Plant Electrolyzing Team No. 3, of Anaconda Copper Mining Company, Great Falls Reduction Department, Great Falls, Mont.

Standing—left to right: Matt L. Parock, Edward Schrader, Michael Tetrault, and Fred I. Erickson (captain). Seated—left to right: Nels C. Nelsen (patient) and Raymond F. Lipton.

NOT often does any publication have an opportunity to present to its readers so splendid an example of the type of labor that characterizes American industry as is illustrated in the picture of Anaconda's Zinc Plant Electrolyzing Team No. 3, which won first place in the Bureau of Mines International Contest at Butte, Mont., on Aug. 20-22 of the current year. Individually, and as a group, the men comprising the team look the part, and fit into the rôle, of winners. The photograph from which the illustration was made created in the office of *E. & M. J.* keen interest in the personnel of the team, and an inquiry was addressed to Mr. B. B. Thayer, Vice-President of the company by which they are employed, concerning the nationality of the men, their respective ages, and the kind of work in which each had been engaged. Mr. R. B. Caples, Acting General Superintendent, has courteously supplied the desired information. The caption under the illustration will serve to identify the individuals of the team. Brief details as to age, birthplace, and employment of each man follow:

Matt L. Parock, age 29, was born at Great Falls, Mont. He is a weigher in the Zinc Casting Division. Edward Schrader, 28, born at Rochester, Minn., is a zinc-sheet stripper in the Electrolyzing Division, in which department Michael Tetrault, 37, born in North Dakota, and Nels C. Nelsen, 36, born in Norway, are also employed. Raymond F. Lipton, 31, born in Minnesota, is a weigher in the Zinc Casting Division; and Fred I. Erickson, 27, captain of the team, also born in Minnesota, is a zinc-sheet stripper in the Electrolyzing Division. In the contest Nels C. Nelsen acted as the "patient."

The personnel of the various teams participating in the meet was of exceptionally high order. *E.&M.J.* has received other group photos of merit and interest. Space limitations unfortunately preclude their presentation at this time. All companies which sent teams to the recent meeting were worthily represented.

The professions and the arts would find difficulty in assembling a group of individuals of more interesting personality than the six men on Anaconda's winning team. Both the company and the men themselves deserve the acclaim of the industry which they represent so well.

Recent Technical Publications

Geophysical Prospecting Methods

GEOPHYSICS IN MINING. By E. de Hautpick, Elphick Dennis and Company Print, Adelaide, South Australia.

THIS pamphlet presents in sixteen pages a brief general review of the geophysical methods of prospecting. Without going into details of their fundamental principles, the author discusses primarily the successes and experimental data that have been obtained in oil and mining. Only in the radioactive method are physical principles discussed; much more space is devoted to this method than to the others. The author aims to prove that it is far superior to all the others. Anyone who has only a fair idea about the successes of the other geophysical methods knows that statements like the following, intended to detract from their merits, are contrary to the facts: The author states, for instance, that "the torsion balance, which gives the differential in millionth of the density of adjacent portions of the earth (!) has been neglected during the last two years by practical men in the United States"; that "there may be glacial underground boulders which will be registered by the torsion balance as 'dome' structure of an oil pool"; that "in all geophysical methods, except radiometric methods, there are complications in the interpretations," and so on; that "the cost of the seismic method is $150,000 per annum without field expenses"; that "the electric prospection by equipotential lines can only disclose the approximate position of a conductor to the depth of a few feet," etc. He refers only to alternating-current equipotential line methods and omits the successes obtained in prospecting with Schlumberger's and Gish's direct-current methods (he mentions the self-potential methods only), and with the inductive processes as perfected by Sundberg, Radiore, Mason, and others. In the opinion of the reviewer, electrical methods of prospecting are more important today than all other methods in mining. The reader will be amused at the totally impossible physical properties which the author attributes to "air ions." Here is an example: "production of an instantaneous revival of magnetism when air ions fall upon a recently demagnetized piece of iron." The author concludes that "on the basis of these observations, special apparatus . . . will detect these emanations . . . (and) thus directly the presence in the subsoil of metals and mineral oils."

The author may rest assured that experiments made in the last four years in Russia and Germany with the radioactive method have revealed so far that in practice their application is limited to the detection of crevices or fault lines and mineral dikes, provided that the latter outcrop or are covered only by a thin layer of overburden. If the thickness of the overburden exceeds a few feet or, at the most, a few meters, the presence of the geologic disturbances mentioned above cannot be detected.

Golden, Colo. C. A. HEILAND.

THE MINERAL INDUSTRY. Its Statistics, Technology, and Trade During 1927. Vol. XXXVI. McGraw-Hill Book Company, 370 7th Ave., New York. Pages 766. Price $12.

A saving of eighty-eight pages as compared with "The Mineral Industry" for 1926 has been effected in this volume by the publishers, despite the inclusion of a five-page chapter on slate, by Charles H. Behre, Jr., and the expansion of the section on tungsten. The decrease is most noticeable in the chapter on aluminum and bauxite, which is unsigned this year. The other sections that have been curtailed are those on arsenic, bromine and iodine; gold and silver; lead; precious stones; radium, uranium and vanadium; selenium and tellurium; sulphur, pyrite, and sulphuric acid; titanium and zirconium; and zinc. The new volume is the better for this greater brevity.

PATENTS, LAW AND PRACTICE. Fourth Edition. By Oscar A. Geier. Richards and Geier, patent attorneys, 274 Madison Ave., New York. Copy free on request. Pages 46.

This volume represents a complete revison of the third edition, which appeared in 1924. Since then a great many changes are said to have been made in the rules of practice of the U. S. Patent Office, all of which are taken note of. The contents include a digest of patent law and practice; a description of the procedure in the Patent Office; a discussion of so-called interferences, reissues, appeals, disclaimers, infringements, and suits arising thereupon; interfering patents; and various other topics. The nature of and the procedure to be followed in obtaining foreign patents is also covered.

ASBESTOS—A review of the world asbestos situation in the first half of 1928 is given in the Sept. 24 issue of *Commerce Reports*, published by the U. S. Department of Commerce.

GRAPHITE—A short paper discussing the imports of graphite into the United States during the first six months of 1928 appears in *Commerce Reports* for Sept. 17. Imports of all varieties during the period mentioned showed an increase of 882 tons over those of the corresponding period for 1927. The quantities entered were 11,577 and 10,695 tons, respectively.

CUYUNA GEOLOGY—The September-October issue of *Economic Geology* contains an article entitled "Geologic Structure of the Cuyuna Iron District, Minnesota." This is by Carl Zapffe, manager of iron ore properties for the Northern Pacific Railway.

ONTARIO MINING—Bulletin No. 65 of the Ontario Department of Mines, contains in its eight pages a summary of the mineral production of the province during the first six months of 1928. It has been prepared by W. R. Rogers and A. C. Young.

HUDSON BAY RESOURCES—The August issue of the *Canadian Mining and Metallurgical Bulletin* contains an article entitled "The Natural Resources of the Hudson Bay Basin." The author is R. B. Stewart, chief medical officer for the Hudson's Bay Company.

GRAB WINCHES—The progress in the design of grab winches is discussed in an eleven-page article contained in the October issue of *Demag News*, the quarterly publication of Demag, in Duisburg, Germany. This article is amply illustrated by line drawings showing various details of construction.

CORROSION—One of the papers intended for publication at the forthcoming annual meeting of the Iron and Steel Institute in Great Britain is that entitled "The Phenomena of Corrosion of Iron and Steel." The authors are A. Herrero and M. de Zubiria, both of Bilbao. The paper contains sixteen pages.

GRAPHITE FLOTATION—H. B. Menardi, of the Southwestern Engineering Corporation, Los Angeles, is the author of an article entitled "Modern Concentration Plants for Graphite," in the Sept. 1 issue of *Rock Products*. The plant described is that of Southwestern Consolidated Graphite, which was designed and erected near Burnet, Tex., by Mr. Menardi's company.

EMPIRE CONGRESS—An echo of the visit of the Empire Mining and Metallurgical Congress to Canada last year is contained in the August issue of the *Journal* of the South African Institution of Engineers. This is in the inaugural address of the recently elected president, P. M. Anderson. Mr. Anderson was among the visitors to Canada and devoted his paper largely to his impressions. He is head of the Union Corporation, Limited, of Johannesburg.

MINE SAFETY—Among the papers presented at the recent meeting of the National Safety Council is one entitled "Educating the Miner in Safety," by Cleveland E. Dodge, vice-president of the Phelps Dodge Corporation. Another, entitled "Training the Mine Foreman," is written by H. S. Gilbertson of the Lehigh Coal & Navigation Company. Mr. Gilbertson states that recently his company has initiated a policy of publicity which relates to practically everything directly or indirectly associated with proper mine operation, as a step in the education of the foreman.

Personal Notes

ABBOT A. HANKS, of San Francisco, has returned from a vacation in Europe.

FREDERICK G. CLAPP, who has been engaged in professional work in Persia, is in Paris on his way back to New York.

FOSTER S. NAETHING, consulting mining engineer, has moved from Joplin, Mo., to St. Louis, where his address is 709 Skinker Road.

L. P. VAN ZYL HAM, formerly secretary of the South African Public Service Commission, has been appointed Secretary for Mines and Industries of the Union.

LEON GABRIEL has been appointed manager of the South American Manganese Company, an English company that will develop properties in the State of Minas Geraes, Brazil.

FREDERICK LAIST, general metallurgical manager of Anaconda Copper Mining, is on his way to Kattowitz, Poland, to spend several weeks at the company's mines there.

S. L. MCDONALD, formerly with Hollinger Consolidated, has been appointed consulting engineer to the Night Hawk, which operates in the Porcupine area of northern Ontario.

F. E. MATTHES, of the U. S. Geological Survey, is to undertake a study of the geologic history of the Mississippi River and its tributaries, with particular regard to the problem of flood control.

Prof. and Mrs. MARK EHLE have returned to Tucson, Ariz., after a six-month tour through Europe. Professor Ehle will resume his duties at the School of Mines of the University of Arizona.

A. J. REEF, mining engineer of the Compañia Real del Monte y Pachuca, at Pachuca, State of Hidalgo, Mexico, was recently in Denver on his return to Pachuca from Hawaii, where he spent his vacation.

MANUAL VILLAFANA, engineer for the Compañia del Boleo, of Santa Rosalia, Lower California, Mexico, recently made an examination of the Foster mines, at Shadow Mountain, San Bernardino County, Calif.

ARTHUR CROWFOOT, superintendent of the concentrating division of the Phelps Dodge Corporation at Morenci, Ariz., was in New York this week, for the meeting of the Safety Congress at the Waldorf-Astoria Hotel.

MAJOR MAASDORP, formerly with Nourse Mines, is in charge of development at the Forbes Reef and Ivanhoe mines, in Swaziland. These mines are included in the mineral rights owned by the Swaziland Corporation, Ltd.

H. SAUNDERS, mine superintendent of the Broken Hills mine, in Northern Rhodesia, visited the mining districts of Arizona in the latter part of September. He will leave for Rhodesia from New York in the near future.

S. R. CAPPS, GERALD FITZGERALD, P. S. SMITH, and R. H. SARGENT are among the members of the U. S. Geological Survey who are returning to Washington after conducting geologic work in Alaska during the summer.

ARTHUR B. PARSONS, recently resigned as associate editor of *E.&M.J.*

A. B. PARSONS

to become vice-president of the Mineral Reseach Corporation, 120 Broadway, New York City.

T. J. GRUPPING arrived in South Africa recently to take charge of the new diamond-cutting plant which will be built at Kimberley. Mr. Grupping was formerly manager of the Van Dam plant, in Amsterdam, The Netherlands.

WILL IRWIN will speak on Oct. 8 at a meeting of all engineering societies at the auditorium of Engineering Societies Building, in New York City. His address will be followed by a motion picture film, "The Master of Emergencies."

Major - General Sir FREDERICK LOOMIS, president of Power & Mines Corporation, Ltd., and R. A. DARWIN, a director of the same company, recently inspected the Grace mine, in the Michipicoten district of northern Ontario. W. E. SIMPSON is consulting engineer of the property.

B. DUNSTAN, chief government geologist of Queensland, Australia, is being dispatched by the government of that state to Germany, to inquire into and report on geophysical research generally. Mr. Dunstan, who is making a special study of this science, has lately accompanied over several parts of Queensland BROUGHTON EDGE, director of the Imperial geophysical experimental survey, now operating in Australia.

CURTIS L. WILSON, formerly associate professor of metallurgy at the Montana State School of Mines, who has been studying in Europe for the last two years, and who received his doctorate at Göttingen last spring, has returned to the School of Mines and has been made head of the department of metallurgy. Professor Wilson will speak on "Educational and Research Methods in European Universities" on Oct. 8, before the Montana Society of Engineers at Butte.

TORGUS H. OAAS, foreman of the Belmont mine of Anaconda Copper, has been made assistant general superintendent of mines for the company and placed in charge of the Belmont, Anaconda, and St. Lawrence mines. JOHN NORTON, formerly foreman of the Diamond mine and recently in charge of the Orphan Girl, has been put in charge of the Belmont. JOHN DUGAN succeeds Mr. Norton as foreman of the Orphan Girl. All three of these men started with Anaconda as miners.

OBITUARY

THOMAS N. STANTON died in Oruro, Bolivia, on Aug. 4, after a sudden illness. Mr. Stanton, who was 58 years old, had been mine superintendent at Cananea and Parral before going to Bolivia about fifteen years ago.

THEODORE CHARLES ROBERTS died in New York on Sept. 20 at the age of 52. Mr. Roberts was for a time associated in a consulting capacity with the Guggenheim interests in Colorado and the Clark interests in Arizona. During the World War he manufactured dyestuffs and chemicals and thereafter turned his interests to fields outside of mining.

LYMAN MCEWEN, mill superintendent of the O'Brien silver mine, in the Cobalt district of Ontario, died on Sept. 23. Mr. McEwen, who was 41 years old, was a graduate of Queens University, Kingston, Ont. He became associated with the O'Brien interests in 1912. During the war he served with the Canadian forces overseas. In 1920 he was appointed mill superintendent.

ROBERT P. ROBERTS, chief metallurgist for the Mount Lyell Mining & Railway Company, Queenstown, Tasmania, died suddenly of cerebral hemorrhage on Tuesday, Sept. 11. Mr. Roberts graduated from the Massachusetts Institute of Technology about 1901. He accepted a position in Tasmania twelve years later, resigning from the staff of Anaconda Copper where he was employed as general smelter foreman at Great Falls, Mont. For 25 years he had been a member of the A.I.M.E. A widow and five children survive him.

MARKET AND FINANCIAL NEWS

A.S.&R. Earnings Practically Unchanged from 1927 and 1926

AMERICAN Smelting & Refining earnings on the common stock at the rate of $21.21 for the year 1928 are indicated in the company's semi-annual report, just issued. For the six months' period ending June 30, the report shows earnings of $6,469,451 on the common stock, or $10.60 per share. These earnings are computed after deducting bond interest, depreciation, obsolescence, ore depletion, taxes, and dividends on the preferred stock. The company's earnings on common stock during the same period of 1927 were at the rate of $11.08 and in 1926 at the rate of $11.65. Net income before dividends was $8,219,451 for the period, in contrast with $8,507,944 for the first six months of 1927. Surplus income for the period, after deducting dividends on preferred and common stock, was $4,029,531. This compares with $4,318,-024 in the corresponding period of 1927.

In connection with the company's earnings on common stock, President Simon Guggenheim points out in his report to stockholders that "This figure is obtained after charging against earnings $459,807.50, representing unamortized bond discount and expense applicable to, and the premium on, $4,250,-000 Series B 6 per cent bonds called for payment April 1, 1928. If the bonds had not been retired, the earning on the common stock for the period would have been $11.27 per share, or at the rate of $22.54 per year. The annual interest on the bonds called is equal to an earning of 42c. per share per year on the outstanding common stock."

Total current and miscellaneous assets amount to $95,631,076, which is more than 4.74 times the total current and miscellaneous liabilities of $20,169,836. On June 30, 1928, the company had on hand, in cash, call, and time loans and federal government securities, $36,848,497, an increase of $1,465,679 over the same item on Dec. 31, 1927.

Mesabi Iron Offers New Stock

The Mesabi Iron Company is offering to holders of its 786,267 outstanding shares rights to subscribe to 196,567 shares of new stock in the ratio of one share for each four shares of the old stock held, the price being $2 a share. Recent quotations on the old stock have been from $2.50 to $2.75 a share. D. C. Jackling, president of the company, states that the property has been idle for four years and that the company owes $375,000. Returns from the sale of the new shares will put the company in better financial position, and operations will be resumed when considered practicable. The company owns large reserves of low-grade iron ores on the Mesabi range, with a 2,500-ton concentrating plant at Babbitt, Minn. It was described in the *E.&M.J.* of Jan. 26 and Feb. 2, 1924.

Copper Consumption by Important Industries in 1927 and 1928

ACCORDING to the American Bureau of Metal Statistics, estimated consumption of copper in three of the important copper-requiring industries of the United States in the second quarter of 1928, and in previous quarters, is as follows, in tons of 2,000 lb.:

1927	Elec. Mfrs.	Automobiles	Buildings	Mfrs. for Export
First quarter...	45,500	24,100	11,300	12,800
Second quarter.	49,000	28,300	10,700	15,600
Third quarter..	48,000	24,600	12,800	14,200
Fourth quarter.	54,000	17,600	11,300	13,500
Total.....	196,500	94,600	46,100	56,100
1928				
First quarter...	45,000	26,600	11,400	16,400
Second quarter.	54,500	32,000	12,100	15,600
Total.....	99,500	58,600	23,500	32,000

The sum of the quarterly estimates of the use of copper in automobiles usually underruns the annual revised estimate.

Canadian Production of Iron Oxides

Production of iron oxides from Canadian deposits in 1927 amounted to 6,125 tons, valued at $103,536, most of the production coming from Quebec. During 1926 shipments totaled 6,626 tons, worth $101,843. The Canadian production of iron oxides is marketed in two forms—namely, crude and calcined. Crude oxides are dried before shipment for use in the purification of illuminating gas, whereas the calcined product is ground, usually for consumption in the paint industry.

Quincy Mining Considers Increase in Capitalization

A SPECIAL meeting of the stockholders of Quincy Mining, which operates properties in the Michigan copper district, will be held Oct. 15, 1928, at the office of the company in New York. The purpose of the meeting is to consider a proposal to increase the company's capitalization.

The capital stock of the company consists of 150,000 shares of $25 per share par value. It is proposed to issue an additional 50,000 shares of the same par value, to be offered to stockholders on the basis of one share of new for each three shares of old stock held. Such stock as is not subscribed for by stockholders will be sold by the directors at not less than $25 per share.

MARKET COMMENT

Copper Buying Is Quiet in Arizona While New York Market Boils

ONE reads with interest in the Sept. 15 issue of the Arizona *Mining Journal,* in its famous "Digest of the Metal Situation," that "There is no great buying excitement in copper, as the buying for home consumption is largely confined to small lots for immediate delivery, the September requirements having largely been purchased." This is quite a contrast to what happened in New York, where, in the week of Aug. 30 to Sept. 5, sales were about twice normal, and in the week of Sept. 6 to Sept. 12 were at the highest level in years. The continued effort to write about something without any first-hand knowledge reminds us of a story. "Have you ever driven a car?" the lady applicant for a license was asked. "One hundred and twenty thousand miles," put in her husband, who was standing near by, "and never had a hand on the wheel."

Judging Copper Production by Prices of Copper Stocks

"ONE WONDERS," says the *Wall Street Journal,* "what they are going to do with all the copper the old mines are finding, if the new deposits are as extensive as the prices of some copper stocks indicate." This observation is made after considering the stock-market valuations of Greene Cananea, International Nickel, Calumet & Arizona, Quincy, and some others following recent favorable developments underground.

The answer would seem to be that the new deposits are not so extensive as the prices of the stocks indicate; or, more properly, the prices of the stocks are out of all proportion to the probable profits to be secured from the new orebodies discovered. In this kind of a market, however, as the *Wall Street Journal* has also remarked, some traders profit by their own lack of intelligence.

The Market Report

Metal Markets Quiet—Prices Firm

New York, Oct. 3, 1928—Copper buying has dropped back to normal proportions or less, and none of the other principal non-ferrous metals have had any unusual activity. Prices of copper, lead, and zinc are virtually unchanged from recent levels. Silver and tin are somewhat higher than a week ago, the flurry in tin culminating at 50c. on Monday. General industrial conditions for the remainder of the year are expected to be excellent.

Copper Demand Abates

The week ending today has been the quietest in copper for over two months, but the breathing spell is welcome to the producers. September sales for combined domestic and foreign account approximated 500,000,000 lb., a record that is likely to stand for some time. Foreign sales, though large, did not quite equal the huge tonnage sold in May.

Prices are entirely unchanged, at 15¼c. Connecticut basis, and 15⅜c. in the Middle West, with shipment fairly divided between November and December, though a few hundred tons were also sold for October. Export prices continue at 15½c., c.i.f. The indications are that foreign consumers still have considerable copper to buy for fairly early delivery, but domestic requirements should be well covered through November. Not a great deal has been sold yet for December, but it is possible that there may be a carry-over into that month, and with the disinclination to carry large stocks at inventory time, into the new year, buying for shipment in December may not be so great as for October and November.

Lead Firm and Steady

Lead continues in active demand, though the total sales for the week ending today have been smaller than in the two weeks preceding. Producers' prices remain consistently at 6.50c. per pound in New York, the level of the American Smelting & Refining Company's contract price, and 6.325c. per pound East St. Louis basis. Resale metal in good-sized lots has been offered at 6.30c. per pound, though data on actual transactions are not forthcoming. Cable and battery manufacturers were responsible for a large proportion of the week's sales tonnage. Corroders took considerably more lead than for some weeks. Lead has sold in better than average volume for the last eight weeks, and producers appear to feel that an increase in the rate of consumption is at hand. London prices for spot lead advanced steadily during the last week, the backwardation for futures being reduced from 5 to 3½ shillings per long

Average Metal Prices for September, 1928

COPPER:	
New York Electrolytic	14.724
London Standard Spot	63.522
London Electrolytic Spot	69.800
LEAD:	
New York	6.450
St. Louis	6.286
London Spot	22.050
London Forward	21.769
SILVER:	
New York	57.536
London	26.440
Sterling Exchange	484.654
ZINC:	
St. Louis	6.250
London Spot	24.497
London Forward	24.625
TIN:	
Straits	48.073
London	215.663
QUICKSILVER	128.000
ANTIMONY	10.813
PLATINUM:	
Refined	78.000
Crude	68.000
ALUMINUM 99 PER CENT PLUS.	24.300

Daily Prices of Metals

Sept. Oct.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
27	15.025	49.625	6.50	6.325	6.25
28	15.025	49.375	6.50	6.325	6.25
29	15.025	49.875	6.50	6.325	6.25
1	15.00@15.05	50.00	6.50	6.325	6.25
2	15.025	49.625	6.50	6.325	6.25
3	15.025	49.50	6.50	6.325	6.25
	15.025	49.667	6.500	6.325	6.250

Average prices for calendar week ending Sept. 29, 1928, are: Copper, 15.025; Straits tin, 49.271; N. Y. lead, 6.500; St. Louis lead, 6.327; zinc, 6.250; and silver, 57.375.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis: that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Sept. Oct.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
27	64½	65	71¼	224½	220⅜	21 11/16	21 7/16	24	24 3/16
28	64 7/16	64 15/16	71¼	225¾	222¼	21 11/16	21 7/16	24 1/16	24¼
1	64⅝	65⅛	71¼	227¾	223½	21¾	21 9/16	24 1/16	24⅜
2	64⅝	65	71¼	224	220⅞	21 15/16	21¾	24 1/16	24⅜
3	64½	64⅞	71¼	222⅜	220⅛	22 1/16	21⅞	24⅛	24 7/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Sept.	Sterling Exchange "Checks"	Silver		Gold London	Oct.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
27	4.84 9/16	57½	26½	84s11½d	1	4.84 9/16	57⅞	26⅝	84s11½d
28	4.84 9/16	57⅜	26 7/16	84s11½d	2	4.84½	57⅝	26 9/16	84s11½d
29	4.84 9/16	57⅝	26 9/16	.....	3	4.84 9/16	57¾	26⅝	84s11½d

Avg. 57.625

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pense per troy ounce of sterling silver, 925 fine. Sterling quoations represent the demand market in the forenoon. Cables command three-eighths cent premium.

ton. Should there be further price advances in London, with a continuation of the activity in the domestic market, higher prices here may result.

Zinc Unchanged

Nothing new can be reported in the zinc market, either as regards price or volume of sales. All Prime Western business reported by producers has been at the 6.25c. East St. Louis level, in spite of the fact that some galvanizers report that the metal is available at 6.225c. A fair tonnage has been sold—about the same as last week—but it is felt that recent buying has not been on as great a scale as the consumption. The major demand has been for October shipment. Spot carloads of High-Grade are 7½c., delivered in the East.

Tin Continues Active

Consumer demand for tin during the last week has been very good. Bullish news from London likewise has served to stimulate the market, with the result that prices reached 50c. per pound on Monday, though a slight downward reaction has taken place subsequently. Exercising of options in London has served to advance prices there. Reports have it that the Anglo-Oriental security issue, recently offered in London, was oversubscribed by a considerable margin. Thus it would appear that the tin bulls in London are not without support.

Silver Quiet but Steady

Silver has been less active, both here and abroad. Buying by China and occasional orders from India have been the supporting features, and the undertone appears steady to firm.

Mexican Dollars (Old Mexican pesos): Sept. 27th, 43⅝c.; 28th, 43½c.; 29th, 43¾c.; Oct. 1st, 44c.; 2d, 43¾c.; 3d, 43⅞c.

Sterling at New Low

Sterling exchange reached a new low, and gold has been shipped from London. Closing cable quotations on francs, lire, and marks, on Tuesday, Oct 2, follow: Francs, 3.91c.; lire, 5.23⅛c.; and marks, 23.825c. Canadian dollars, ⅛ per cent discount.

Tri-State Resumes Production

Joplin, Mo., Sept. 29, 1928

Blende	Per Ton
High	$40.85
Premium blende, basis 60 per cent zinc	$40.00@ 41.00
Prime Western, basis 60 per cent zinc	40.00
Fines and slimes, 60 per cent zinc	36.00@ 39.00
Average settling price, all zinc	39.46
Galena	
High	$86.60
Basis 80 per cent lead	85.00
Average settling price, all lead	83.79

Shipments for the week: Blende, 6,004; galena, 1,648 tons. Value, all ores the week, $375,010.

Production was resumed this week to within 15 per cent of the normal output preceding the closing of the mines last week. Shippers are buying, but withholding shipments awaiting the new traffic schedule effective Oct. 10, by which approximately 45c. per ton will be saved. Advance payments are made on ore purchased so that sellers need not lower their bank balances to meet labor expenses. Buying 80 per cent of the output and shipping only 60 per cent suggests an increase in stocks, but with resumption of shipping it is believed stocks will be materially decreased.

Platteville, Wis., Sept. 29, 1928.

Zinc Blende	Per Ton
Blende, basis 60 per cent	$42.75
Lead Ore	
Lead, basis 80 per cent	$86.00

Shipments for the week: Blende, 920 tons; lead, 45 tons. Shipments for the year: Blende, 27,906 tons; lead, 1,490 tons. Shipments for the week to separating plants, 1,433 tons blende.

Iron and Steel Markets Strong

Pittsburgh, Oct. 2, 1928

From a low point in June, steel production increased during the second quarter. September production of steel ingots, estimated at 4,000,000 long tons, represented 85 per cent of capacity, against 76 per cent in June, and the rate Oct. 1 was somewhat above the September average. Production in nine months was about 8.9 per cent over 1927 and 3.8 per cent over 1926, the record year.

The exceptionally heavy demand for steel in the last three months compared with the same period in other years was due chiefly to large line pipe buying, beginning late in June, chiefly for natural-gas lines; to the automobile industry running at an altogether unusual pace; to a record high demand for fabricated structural steel, lettings of contracts having been exceptionally heavy beginning with May; and to the fact that the agricultural-implement industry had an unusually small slowing down for the summer.

Various price advances were attempted, to be made effective late in September, in bars, shapes, plates, sheets and strips. These advances stimulated both new buying and specifying on third-quarter contracts,

Bar, shape, and plate consumers will pay $1 to $2 a ton more for fourth-quarter than for third-quarter supplies, but the full advanced price of 2.00c., Pittsburgh, promises to be largely a nominal market, applying at best on only small current lots. Advanced prices of 2.75c. on black sheets and 3.50c. on galvanized sheets have come into effect.

Pig Iron—In most districts, prices were advanced during September, after consumers had covered rather fully. In the Valley market there has been little test, ranges between former realized prices and present asking prices being $17@$17.50 for bessemer, $15.75@$16.50 for basic, and $16.50@$17 for foundry.

Connellsville Coke—Requirements are a little heavier on all grades. Spot furnace is unchanged at $2.75 and spot foundry at $3.75@$4.25.

Other Metals

Quotations cover large wholesale lots f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.: 98-99 per cent, 23.90c. Demand good, especially in the automobile and electrical industries. London, 98 per cent, quoted at £95 per long ton, less 2 per cent, for domestic consumption. Market reported depressed.

ANTIMONY—Per lb., duty paid: Chinese brands, spot, 11⅜c., futures 11¼@ 10⅞c. Cookson's "C" grade, spot, 15⅜c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. Nominal.

BISMUTH—Per lb., in ton lots, $1.70. Smaller lots $1.85 and up. London 7s. 6d.

CADMIUM—Per lb., 70@80c. Active. London, 2s. 6d. for Australian metal.

COBALT — Per lb., f.o.b. Canadian works: Shot, 96@98 per cent, $2.50@ $3, quiet. Black oxide, 70 per cent, $2.10. London, 10s. for metal in small lots, 8s. for black oxide; 8s. 10d. for gray.

[1]GERMANIUM OXIDE — Per gram in 300- to 500-gram lots, $5.

IRIDIUM—Per oz., $280@$300 for 98 @99 per cent sponge and powder. London £57@£60.

[1]LITHIUM—Per oz., 98@99 per cent grade in 1- to 5-lb. lots, $5.

MAGNESIUM — Per lb., in ton lots, single orders for spot metal: 8-lb. ingots (3x3x15 or 16 in.), 85c.@$1.05, depending on quantity; 2½- or 3-lb. sticks (1⅜ in.), $0.90@$1.10, depending on quantity; 10-oz. sticks (1x12 in.), 85@90c. Discounts up to 20 per cent on larger orders or contracts. Market firm. London 4s.@4s. 3d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM — Per gram, 99 per cent, 4c. (Usually sold as calcium molybdate or ferromolybdenum, which see).

NICKEL—Per lb., ingot. 35c.; shot, 36c.; electrolytic, 37c. (99.90 per cent grade), for single lots of spot metal. Market active. London, per long ton, £170@£175 according to quantity.

OSMIUM—Per oz., $55@$65; London, £12@£14.

PALLADIUM — Per oz., $42@$46. London, £10¼@£11½. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $78. Dealers and refiners quote the trade for refined metal, per oz., cash, for wholesale lots, $73.50@$74 bid, $75@$76 asked. Market quiet.

London, per oz., £16¼@£16¾ for refined; crude and scrap, nominal at £15@£15½. Market depressed.

QUICKSILVER—Per 76-lb. flask, $129@ $131. Small lots command the usual premium. Market fairly active. San Francisco wires $131.67. London firm with small offers of spot at £24¼@£24½.

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[1]Price furnished by Foote Mineral Co., Philadelphia.

RADIUM — Per mg. radium content, $70.

RHODIUM—Per oz., $40@$55. Nominal. London, £11@£12.

RUTHENIUM — Per oz., $45@$55. Nominal. London, £9@£10.

[1]SELENIUM — Per lb. in ton lots: Black, powdered, amorphous, 99.5 per cent pure, $2.25. London, 7s. 8d.

TANTALUM — Per gram: Bar and heavy sheet, chemically pure, 20c.; tantalum powder, 11c.

TELLURIUM—Per oz., 15@18c.

THALLIUM METAL — $12.50@$15 per lb.

TUNGSTEN POWDER—Containing 97 to 98 per cent tungsten, per lb., $1.10@$1.20, depending on quantity. Nominal.

[1]ZIRCONIUM METAL—Per oz., 98 per cent grade, $1.56 in 5- to 10-lb. lots.

Metallic Ores

ANTIMONY ORE—Bolivian ore, 60 per cent metallic antimony, $1.40 per short ton unit, c.i.f. New York.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $21 for 47 per cent Cr_2O_3 ore to $23 for 50@51 per cent ore. New Caledonian ore, high-grade, $25. Prices firm.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores.

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range, bessemer, 51½ per cent, $4.55.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 58 to 63 per cent, 8@8½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 10@11c.

Spanish foundry or basic, 50@60 per cent, 8½@10c. Nominal.

Swedish foundry or basic, 66@68 per cent, 9@9½c. Nominal.

Newfoundland foundry, 55 per cent, 8½@9c.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports. Exclusive of duty. Brazilian and Indian ores, minimum 47 per cent Mn, 35@38c. Caucasian (washed), 52@55 per cent, 38@40c. Market firm with consumers well covered by contract.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80. Caucasian, minimum 85 per cent, $70. Montana, 70 to 75 per cent, $70@$80. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of Ta_2O_5, basis 60 per cent ore, $15.

TITANIUM ORE—Ilmenite, per gross ton, 52 to 60 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., 93 per cent concentrate, 10c. for 30-ton lots.

TUNGSTEN ORE—Per short-ton unit of WO_3, N. Y.; Wolframite, $10.70@$10.85. Western scheelite, $11.25. Quiet. Consumers awaiting U. S. Tariff Commission's study of production costs on which a change in duty may be based.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading interest:

Crude No. 1, $600@$650; crude No. 2, $375@$400; spinning fibers, $190@$225; magnesia and compressed sheet fibers, $160@$175; shingle stock, $55@$115, various grades; paper stock, $45@$50; cement stock, $25; short fibers, $10@$20; floats, $15. Market firm, demand good for all grades.

Per ton c.i.f. New York: Rhodesian crude No. 1, $450; No. 2, $350.

BARYTES—Per ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude (per long ton), $7. Washed and water floated to 97 per cent through 300 mesh, $19. Shipments steady but only about 75 per cent of normal.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $6.50, f.o.b. mines. Market good.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7.50@$8, f.o.b. *Georgia* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $7.50@$8.50 f.o.b. *Georgia-Alabama* mines. Pulverized and dried, $14; calcined, 78 to 84 per cent Al_2O_3, $18@$20.

Per metric ton, foreign, c.i.f. Atlantic port: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.80@$6.50; Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 5 per cent SiO_2, $6@$8.

BORAX—Per lb.: Carload lots, in bags, crystals, 2¾c.; granulated or powdered, 2½c.; f.o.b. consumers' shipping point. Market good.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$18; ground, $7@$10.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour, No. 1, $20; No. 2, $17. Market fair.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots. Slow.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $45@$50.

DIATOMITE — Per short ton, f.o.b. plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in., $18@$20; air-floated powder, $45. Over 85 per cent silica, 98 per cent through 200 mesh, $25@$26, depending on quantity.

EMERY — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½c. Market fair to good.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $5@$7.50; glass grades, $5@$6. Market fair.

No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 20 mesh, $10.25; 90 mesh, $12; 140 mesh, $13.75; 200 mesh, $15.50. No. 3, 20 mesh, $9. Market somewhat improved.

New Hampshire, per ton: Pottery grade, $8. Best quality lump, $9.

New York, Per ton: f.o.b. cars, No. 1 crude, $9. Market improving.

Maine, per ton: Best pottery grade, ground, $19. Market slow.

FLUORSPAR—Per ton: F.o.b. *Kentucky* and *Illinois* mines.

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $17@$18. Foundry lump, 85-5, $18@$19. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Market quiet.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16.50; 94-3 lump, $21; 96-3 sacked, $35. Market poor.

Foreign spar, duty paid, $15.50, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 16 to 60 mesh, $17; 60 to 90 mesh, $14; 100 mesh up, $7. Market fair.

Powdered, import duty paid, $24@$25 per ton.

GARNET — Per ton; domestic, f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50. Normal market.

GRAPHITE—Per lb.: F.o.b. *New York.*

Ceylon lump, 8@8½c.; chip, 7@7½c.; dust, 3@5½c.; Madagascar flake, 7@7½c.

No. 1 flake, 8c. and up. No. 2 flake, 5c. and up. Foundry facings, 3c. and up. Graphite facings, 4c. and up. Amorphous and crystalline, fine ground, 3c. and up. Market active but very competitive.

Crude amorphous graphite, $15@$35 per ton, according to grade. Unchanged.

[1]Price furnished by Foote Mineral Co., Philadelphia.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade in carload lots, $25. Market very quiet.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $1.70@$6; ground, $4@$9; agricultural, $4@$9; calcined, $6@$13.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$3.

Agricultural, 75c. up to $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $43; Grade B, $40; dead burned, $29; crude, $11; high-purity periclase, f.o.b. Eastern seaboard, calcined, $40. *Washington:* Dead-burned magnesite, $22@$24 per net ton, Chewelah, Wash.

MICA—Per ton, f. o.b. plant:

New Hampshire: Mine run, $320; clean shop scrap, $25; roofing, $24. White dry ground, 20 mesh, $25; 40 mesh, $38; 60 mesh, white, $60; off-color, $34; 100 mesh, $70; 200 mesh, $80. Granite-mica facings for cement block and stucco use, $8@$12, depending on size between ¼ in. and 10 mesh. Market fair.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, per lb., f.o.b. *New York*, duty paid: No. A1, $2.50; No. 1, $2; No. 2, $1.65; No. 3, $1.15; No. 4, 60c.; No. 5, 45c. Market slow.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $130.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18. Market good.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10. Prices firm.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4.

Tennessee, ground, 90 per cent through 200 mesh, 33 per cent P_2O_5, $11.20 per short ton. Brown lump for acid manufacture, per gross ton, $6 on 75 per cent basis; $5.25 on 72 per cent basis. Non-acidulated, fine ground, 65 per cent, $8 (per short ton). Ground and lump very active.

POTASH—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent....	36.40	34.80
Sulphate of potash 90 @ 95 per cent, basis 90 per cent....	47.30	45.70
Sulphate of potash-magnesia 48 @ 53 per cent, basis 48 per cent	27.25	25.65
Manure salt 30 per cent.....	21.75	18.75
Manure salt 20 per cent.....	15.40	12.40
Kainit 14 @ 16 per cent.....	12.50	9.50
Kainit 12.4 per cent.....	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: C.i.f. United States ports; guaranteed 48 per cent sulphur, Spanish, 13c.; Tharsis, furnace size, 2½ in. diameter, 14c. Cinder from ore to remain property of buyers. Quiet.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. For optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois: 400 mesh, $31; 350 mesh, $26; 250 mesh, $18. Market fair. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35@$3.50. Market quiet.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content. Nominal.

SULPHUR—Per ton for domestic market, $18, f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Open prices $1 higher than above.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $9.50@$10; 97½ to 98½ per cent through 200 mesh, medium white, $9@$9.50; packed in 50-lb. paper bags; prices $1 per ton less in burlap sacks.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75. Market fair.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9.

New Jersey: Soapstone, ground, $10@$12.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh; rose and cream colored, $14. Double ground through 110 mesh; rose and cream, $17. Air-floated through 200 mesh, rose and cream, $25; mill run, $15. Good fall business.

Metallic Compounds

ANTIMONY OXIDE—White, Chinese, 99 per cent Sb_2O_3, 15½c. per lb.

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c.; delivered near by. Market firm. London, per long ton, £16½@£17 quoted for Cornish white; Mexican high grade, £17 17s. 6d., c.i.f. Liverpool.

CALCIUM MOLYBDATE OR MOLYTE — Per lb. of contained Mo, 95c., delivered. Good demand.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 5.30c., for either large or small crystals. Quiet.

SODIUM NITRATE—Per 100 lb.; crude, in bags ex vessel, Atlantic ports, $2.15 for spot; future delivery, $2.17½@$2.20.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, 87 per cent, $15@$17; 94 to 96 per cent, $19@$20.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

Alloys

[1]FERROCERIUM—Per lb., $9 in 15 to 75 lb. lots.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 11c. Spot shipments ½c. higher. Freight allowed in carload lots east of Mississippi River and north of Baltimore.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $105. Spiegeleisen, 19@21 per cent, $33 on carload business, f.o.b. furnace. Demand more active.

FERROMOLYBDENUM—Per lb. of Mo. f.o.b. shipping point, 50@60 per cent Mo, $1.20. Active demand.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent. $122.50; f.o.b. *Alabama* and *Tennessee*

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River and north of Baltimore: 50 per cent, $83.50; 75 per cent, $130; 15@17 per cent, $45, f.o.b. Suspension Bridge, N. Y. Quotations for spot shipments slightly higher. Market active.

FERROCARBONTITANIUM — Per ton: For 15 to 18 per cent material, $200, f.o.b. Niagara Falls, N. Y.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, 96c., f.o.b. works.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, freight allowed, $3.15@$3.65, depending on grade and quantity.

MONEL METAL—Per lb. base price for shot, 28c., f.o.b. Huntington, W. Va.

NICKEL SILVER—30¼c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL—Dimension sheets, 20¾c. per lb.; rods, 17¾c. per lb.

Rolled Metals

COPPER — Sheets, hot-rolled, 24c.; wire, 17⅛c. per lb., f.o.b. mill.

LEAD SHEETS—Full rolled, 10c. per lb.; clipped, 10¼c.

ZINC SHEETS — Per lb., 9¾c., f.o.b. works.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE—Brick, per net ton, f.o.b. works: 9-in. straights, $65. Cement, $40, seaboard.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio,* $43; *Alabama,* $51; *Illinois,* $52.

[1]ZIRKITE—Per lb.: Powdered, 80 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1927	1928	1927	1928	1927	1928
January	55.795	57.135	25.863	26.313	484.775	487.098
February	57.898	57.016	26.854	26.205	484.551	487.008
March	55.506	57.245	25.655	26.329	484.887	487.558
April	56.399	57.395	26.136	26.409	485.178	487.785
May	56.280	60.298	26.072	27.654	485.288	487.685
June	56.769	60.019	26.203	27.459	485.183	487.565
July	56.360	59.215	25.983	27.262	485.145	485.923
August	54.718	58.880	25.224	27.096	485.546	484.979
September	55.445	57.536	25.565	26.440	485.878	484.654
October	56.035	.....	25.776	.....	486.533	.....
November	57.474	.....	26.526	.....	486.956	.....
December	57.957	.....	26.701	.....	487.714	.....
Year	56.370	.....	26.047	.....	485.636	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic		London Spot Standard		London Spot Electrolytic	
	1927	1928	1927	1928	1927	1928
January	12.990	13.854	55.414	61.912	62.375	66.575
February	12.682	13.823	54.438	61.670	61.119	66.381
March	13.079	13.845	55.935	61.148	62.641	66.443
April	12.808	13.986	55.056	61.678	61.526	66.500
May	12.621	14.203	54.563	62.554	60.881	67.216
June	12.370	14.527	54.030	63.664	59.881	68 738
July	12.532	14.527	54.551	62.881	60.089	68.670
August	12.971	14.526	55.364	62.472	62.227	68.750
September	12.940	14.724	54.455	63.522	61.830	69.800
October	12.958	.....	55.119	.....	62.256	.....
November	13.319	.....	58.830	.....	63.761	.....
December	13.774	.....	60.078	.....	66.181	.....
Year	12.920	.....	55.653	.....	62.064	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1927	1928	1927	1928	1927 Spot	1927 3 Mos.	1928 Spot	1928 3 Mos.
January	7.577	6.500	7.392	6.280	27.485	27.786	21.773	22.213
February	7.420	6.329	7.286	6.069	27.344	27.781	20.283	20.747
March	7.577	6.000	7.328	5.805	27.845	28.302	19.938	20.352
April	7.126	6.100	6.807	5.991	26.546	27.053	20.306	20.563
May	6.616	6.123	6.269	6.012	25.054	25.526	20.483	20.813
June	6.414	6.300	6.150	6.152	24.438	24.750	20.985	21.211
July	6.344	6.220	6.120	6.038	23.491	23.932	20.602	20.957
August	6.681	6.248	6.367	6.056	23.119	23.540	21.634	21.628
September	6.297	6.450	6.044	6.286	21.446	21.994	22.050	21.769
October	6.250	.....	6.013	.....	20.479	20.946	.....	.....
November	6.259	.....	6.035	.....	20.889	21.318	.....	.....
December	6.504	.....	6.319	.....	22.163	22.441	.....	.....
Year	6.755	.....	6.511	.....	24.192	24.614	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York				London	
	1927 99%	1928	1927 Straits	1928	1927 Spot	1928
January	64.785	55.180	66.415	55.650	297.804	253.222
February	66.528	51.793	69.142	52.440	306.125	233.833
March	67.833	51.630	69.199	52.220	313.315	232.722
April	66.069	.....	67.933	52.270	302.572	234.204
May	63.935	.....	67.510	51.582	294.938	230.886
June	64.226	.....	67.466	47.938	296.006	217.280
July	62.625	.....	64.110	47.040	288.690	212.449
August	63.523	.....	64.431	48.012	293.193	212.847
September	60.735	.....	61.490	48.073	280.432	215.663
October	57.560	.....	58.450	.....	264.631	.....
November	57.089	.....	57.641	.....	262.591	.....
December	58.053	.....	58.452	.....	267.138	.....
Year	62.747	.....	64.353	.....	288.953	.....

New York quotations, cents per pound. Quotations on 99 per cent tin discontinued on April 1, because of absence of business. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1927	1928	1927 Spot	1927 3 Mos.	1928 Spot	1928 3 Mos.
January	6.661	5.643	30.979	30.938	26.125	26.051
February	6.673	5.551	29.931	30.109	25.518	25.506
March	6.692	5.624	30.649	30.889	25.082	24.960
April	6.338	5.759	29.579	29.901	25.493	25.316
May	6.075	6.026	29.034	29.131	26.102	25.756
June	6.213	6.158	28.598	28.613	25.664	25.429
July	6.229	6.201	28.280	28.021	24.946	24.972
August	6.342	6.249	28.210	28.068	24.540	24.713
September	6.212	6.250	27.347	27.327	24.497	24.625
October	5.996	.....	26.899	26.634	.....	.....
November	5.745	.....	26.281	26.006	.....	.....
December	5.722	.....	26.363	26.109	.....	.....
Year	6.242	.....	28.513	28.479	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York	
	1927	1928	1927	1928	1927	1928	1927	1928
Jan.	13.910	10.863	101.200	123.620	109.520	79.280	99.820	69.280
Feb.	14.509	10.842	101.727	121.370	107.545	84.783	99.295	74.783
March	12.801	10.083	110.259	122.557	108.000	80.000	100.426	70.000
April	14.166	9.865	123.250	123.740	101.885	80.000	91.865	70.000
May	12.975	11.019	123.900	123.173	84.680	78.000	75.000	68.000
June	12.447	9.750	118.096	122.423	72.000	78.000	62.500	68.000
July	11.880	9.540	119.880	121.260	72.000	78.000	61.520	68.000
Aug.	11.826	10.181	119.111	124.500	72.000	78.000	62.000	68.000
Sept.	11.073	10.813	119.640	128.000	72.000	78.000	62.000	68.000
Oct.	11.165	.....	126.200	.....	72.000	.....	62.000	.....
Nov.	10.763	.....	127.708	.....	72.000	.....	62.000	.....
Dec.	11.195	.....	126.933	.....	72.000	.....	62.000	.....
Year	12.393	.....	118.159	.....	84.636	.....	75.036	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. Prior to June, 1927, the unit had been the 75-lb. flask. (c) Platinum in dollars per ounce.

Pig Iron, Valley[1], and Aluminum 98 Per Cent

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1927	1928	1927	1928	1927	1928	1927	1928
Jan.	19.50	17.50	18.16	17.00	18.50	17.25	26.270	24.300
Feb.	19.02	17.50	18.00	17.00	18.50	17.25	26.000	24.300
March	19.37	17.50	18.28	17.00	18.50	17.25	26.000	24.300
April	19.50	17.50	19.00	17.00	18.50	17.24	26.000	24.300
May	19.24	17.37	18.24	16.38	18.50	16.79	26.000	24.300
June	18.96	17.00	17.96	15.56	18.35	16.79	26.000	24.300
July	18.50	17.00	17.50	15.75	18.00	16.69	26.000	24.300
Aug.	18.50	17.00	17.32	15.75	17.65	16.50	26.000	24.300
Sept.	18.00	17.00	17.11	15.75	17.50	16.50	26.000	24.300
Oct.	18.00	.....	17.00	.....	17.50	.....	25.600	.....
Nov.	18.00	.....	17.00	.....	17.47	.....	25.000	.....
Dec.	17.69	.....	17.00	.....	17.25	.....	24.785	.....
Year	18.69	.....	17.71	.....	18.02	.....	25.808	.....

Iron in dollars per long ton. Aluminum in cents per pound, 98 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

Domestic

	1928 Mar.	April	May	June	July	Aug.
Alaska shipments	3,495	2,084	1,767	2,351	999	2,219
Butte & Superior	†205	.....	.....	†128	.....	.....
Calumet & Arizona	2,019	2,102	2,726	1,991	1,593	2,205
Magma	1,346	1,525	1,451	1,593	1,584	1,427
Miami	2,029	2,092	2,185	2,055	1,756	1,924
New Cornelia	3,318	3,224	2,924	3,050	2,989	3,673
Nevada Con.	†26,288	.....	.....	†31,854	.....	.....
Old Dominion*	1,009	988	1,010	882	819	968
Phelps Dodge††	7,803	8,334	8,083	8,887	8,193	9,330
United Verde Extension	1,699	1,604	1,724	1,670	1,793	2,027
Utah Copper	†27,810	.....	.....	†30,296	.....	.....
Tennessee Copper	596	526	552	527	541	574

Foreign

Andes Copper	2,153	2,152	2,816	4,114	4,315	.....
Braden	8,504	8,506	9,544	8,129	9,079	.....
Boleo, Mexico	1,130	1,012	953	882	.....	.....
Bwana M'Kubwa	533	392	556	542	.....	.....
Chile	7,854	8,155	8,787	9,785	9,969	.....
Furukawa, Japan	1,677	1,559	1,286	1,350	1,274	.....
Granby Cons., Canada	2,326	2,406	2,505	2,345	2,492	2,517
Howe Sound	†4,719	.....	.....	†5,851	.....	.....
Mount Lyell, Australia	†1,510	.....	.....	†1,594	.....	.....
Sumitomo, Japan	1,316	1,483	1,475	1,347	1,611	.....
Union Miniere, Africa	10,689	10,780	10,689	10 120	10,820	10,775

†Three months. *Includes Arizona Commercial
††Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1926 Monthly Production	1926 Daily Rate	1927 Monthly Production	1927 Daily Rate	1928 Monthly Production	1928 Daily Rate
January	71,026	2,291	76,198	2,458	68,469	2,209
February	68,131	2,433	69,202	2,472	67,423	2,325
March	75,728	2,443	69,314	2,236	70.327	2,269
April	73,454	2,448	71,122	2,371	69,721	2,324
May	73,542	2,372	71,613	2,310	73,729	2,378
June	71,317	2,377	69,539	2,318	73,224	2,441
July	72,228	2,330	65,545	2,114	73,426	2,369
August	72,014	2,323	67,248	2,169	77,047	2,485
September	72,672	2,421	65,936	2,198	.....	.....
October	75,099	2,423	68,595	2,225	.....	.....
November	74,947	2,498	68,080	2,269	.....	.....
December	72,205	2,329	67,377	2,173	.....	.....
Total	872,509	.....	829,878	.....	573,366	.....
Monthly average	72,709	.....	69,165	.....	71,671	.....
Average of daily rate	.....	2,390	.....	2,274	.....	2,350

Mining Stocks—Week Ended Sept. 29, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	86	80⅛	82½	Oc.13, No. 19 Q	1.00
Ariz. Com'l	Boston	5⅜	5	5⅛	Jl. 16, Jl. 31 SA	0.25
Cal. & Ariz.	New York	118⅞	111	114½	Se. 7, Se. 24 Q	1.50
Calumet & Hecla	Boston	35½	33½	33½	Au. 31, Se. 15 Q	0.50
Cerro de Pasco	New York	104¾	96½	97¼	Jl.12, Au. 1 Q	1.25
Chile Copper	New York	55⅛	53½	52⅝	Se.15 Se.29 Q	0.62½
Con. Coppermines	N. Y. Curb	12½	11⅛	12⅛		
Copper Range	Boston	23⅜	21	21⅛	Mr. 24, Ap. 20 A	1.00
Crystal Copper	Boston Curb	*32	*28	*29		
East Butte	Boston	3⅜	3	3	Dec., 1919	0.50
Granby Consol	New York	69½	64⅜	67½	Oc.11, No.1 Q	1.00
Greene Cananea	New York	135½	122	128	Se. 14, Oc.1 Q	1.00
Howe Sound	New York	70½	64⅞	66	Se.29, Oc.15, Q	1.00
Inspiration Consol	New York	31½	28	28⅞	Apr. 1927 Q	0.25
Isle Royale	Boston	23½	21⅛	21⅝	Au.31, Se.15 SAX	0.75
Kennecott	New York	103½	100	102	Au.31, Oc 1 Q	1.50
Magma Copper	New York	64¼	58½	59⅜	Oc.1, Oc.15 Q	0.75
Mason Valley	N. Y. Curb	2	1⅞	2		
Miami Copper	New York	25	23⅜	23⅜	Au.1, Au.15, Q	0.37½
Mohawk	Boston	50	48	48½	Jl. 31, Se. 1 Q	1.00
Montana-Idaho	Spokane	*11⅜	*10½	*11		
Mother Lode Coal	New York	3⅛	3⅛	3⅛	Je.8, Je. 30, SA	0.15
Nevada Consol	New York	28⅜	26⅜	27	Se.14, Se.29 Q	0.37½
New Cornelia	Boston	34½	33	33	Au.3, Au. 20 Q	0.50
Noranda	N. Y. Curb	52⅜	46½	47½		
North Butte	Boston	6	4⅞	5	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*83	*71	*80	Sept., 1926	0.03
Old Dominion	Boston	16½	15	15	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	179	160½	176	Se.10, Oc.1 Q	2.00
Quincy	Boston	41	37½	38	March, 1920	1.00
St. Mary's Min. Ld.	Boston	33½	31	31½	Ap.1928 A	2.00
Seneca Copper	New York	4½	3⅜	4		
Shattuck-Denn	N. Y. Curb	20	17⅞	19½		
Tenn. C. & C.	New York	17⅛	15	15⅞	Au., 31 Se.15,Q	0.25
United Verde Ex	N. Y. Curb	18½	16	16½	Oc.6, No.1 Q	0.50
Utah Copper	New York	174	174	174	Se.14, Se.29 Q	2.00
Utah Metal & T.	Boston	1½	1½	1⅜	Dec., 1917	0.30
Walker Mining	Salt Lake	1.85	1.65	1.85		
NICKEL-COPPER						
Internat. Nickel	New York	127⅜	120¼	124	Se.10, Se.29 Q	0.75
Internat. Nickel pfd.	New York	...	...	115	Jl.12, Au.1 Q	1.50
LEAD						
Gladstone Mtn.	Spokane	*4⅛	*4	*4	June, 1927	0.005
National Lead	New York	125	123⅜	123⅞	Se.14, Se.29 Q	1.25
National Lead, pfd. A	New York	142½	142	142	Au.31, Se.15 Q	1.75
National Lead, pfd. B	New York	120½	120½	120½	Oc. 19, No.1 Q	1.50
St. Joseph Lead	New York	47½	45	46⅞	Se.8, De.20 QX	0.75
ZINC						
Am. Z. L. & S.	New York	46⅞	41⅜	44⅞	May, 1917	1.00
Am. Z. L. & S. pfd.	New York	97½	94⅝	94⅝	Nov., 1920	1.50
Butte C. & Z.	New York	8⅞	8	8½	De., 1926	0.50
Butte & Superior	New York	12⅜	10½	10⅞	Se.14,Se.29 Q	0.50
Callahan Zn-Ld	New York	4¼	3¼	3¼	De., 1920	0.50
Consol.Lead&Zinc 'A'	St. Louis	...	...	12½	Je.25, Jl.1 Q	0.25
Eagle-Picher	Cincinnati	18⅜	18⅛	18⅜	No.15, De.1 Q	0.40
Eagle-Picher pfd.	Cincinnati	100	100	100	July 15 Q	1.50
Evans-Wallower	N. Y. Curb	7⅞	7¼	7⅛		
New Jersey Zn.	N. Y. Curb	236	222	222½	Oc.20, Nov. 10 Q	2.00
Treadwell-Yukon	Toronto	14.75	14.00	14.00		
United Zinc	N. Y. Curb	...	...	*60		
Yellow Pine	Los Angeles	*25	*25	*25	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	4⅜	4	4⅛		
Ankerite	Toronto	*30	*22	*30		
Barry-Hollinger	Toronto	*56	*45½	*49		
Central Manitoba	Toronto	*98	*91	*93		
Cresson Consol. G.	N. Y. Curb	*89	*83	*86	Je.30, Jl.10 Q	0.10
Dome Mines	New York	9⅜	8⅜	8⅞	Se.29, Oc.20 Q	0.25
Gold Hill	Toronto	*12	*10	*11		
Golden Cycle	Colo.Springs	†1.65	†1.63	...	My. 31, Je.10 Q	0.04
Hollinger Consol.	Toronto	8.65	8.35	8.35	Se.19, Oc.6 FW	0.05
Homestake Mining	New York	...	...	74	Se.2, Se. 20 M	0.50
Kirkland Lake	Toronto	1.51	1.43	1.47		
Lake Shore	Toronto	22.50	22.05	22.25	Se.1, Se.15, QX	0.20
McIntyre Porcupine	New York	...	...	22	Au.1, Se.1 Q	0.25
Portland	Colo.Springs	††19	††16½	....	Ap., 1927	0.02
Rand Mines	New York	...	...	39½	Au.21-28 Am.Sh	1.52
Sylvanite	Toronto	2.90	2.55	2.55		
Teck-Hughes	Toronto	9.15	8.90	8.90	Jl. 17, Au. 1 SAX	0.15
Tom Reed	Los Angeles	*60	*57	*58	Dec., 1926	0.02
Tough-Oakes	Toronto	*40½	*33	*33		
Vipond Cons.	Toronto	*61	*54	*55	April, 1927	0.03
Wright-Hargreaves	Toronto	3.07	2.75	2.90	Jl.16, Au.1 Q	0.02½
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	20½	20½	20½		
Con. Cortez	N. Y. Curb	*19	*19	*19		
Dolores Esperanza	N. Y. Curb	*90	*90	*90	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb	...	...	15	Jl.18, Oc.28 Q	0.50
Premier Gold	N. Y. Curb	2⅜	2 3/16	2 1/16	Se.14, Oc.4 Q	0.06
Tonopah Belmont	N. Y. Curb	*75	*75	*75	Oc., 1925	0.05
Tonopah Extension	N. Y. Curb	*7	*6	*6	Ap., 1925	0.05
Tonopah Mining	N. Y. Curb	4	4	4	Se 29,Oc 20 SA	0.07½
West End Consol	N. Y. Curb	...	...	*4	Mar., 1923	0.05
Yukon Gold	Boston Curb	*74	*61	*74	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	*98	*98	*98	May, 1920	0.03
Castle-Trethewey	Toronto	*39	*35	*38½		
Coniagas	Toronto	3.50	3.50	3.50	May, 1924	0.12½
Keeley	Toronto	*42½	*42	*42	Mr.1, Mr.15 SA	0.04
Lorrain Trout Lake	Toronto	...	...	*50	July, 1925	0.05
Mining Corp. Can.	Toronto	3.35	3.25	3.30	My.20, Je.13 SA	0.125
Nipissing	N. Y. Curb	3⅛	3	3⅛	Se.29, Oc.20 Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	4	3½	3½	Ap., 1927	0.12½
Bingham Mines	Boston	42	41½	41½	Se.20, Oc.5 Q	0.50
Bunker Hill & Sullivan	N. Y. Curb	...	...	125	Se.29, Oc. 4 MX	0.75
Cardiff M. & M.	Salt Lake	*43	*41	*42	Feb. 5, 1927	0.10
Chief Consol.	Salt Lake	3.60	3.60	3.60	Ja.10, Fe.1 K	0.10
Consti'n Mng. & Mill'g.	Spokane	*36	*36	*36		
Erupcion	Boston Curb	....	....	*18	Ja., 1928 Q	0.07½
Eureka Lily	Salt Lake	2.00	1.75	1.97½		
Federal M. & S.	New York	157	151	157	Je., 1927	10.00
Federal M. & S. pfd.	New York	101	100	100	Au. 24, Se. 15 Q	1.75
Golconda	Spokane	*84	*77½	*78½		
Hecla Mining	N. Y. Curb	15	14½	14⅞	Au.15, Se. 1 Q	0.15
Highland-Surprise	Spokane	*12	*9	*12		
Iron King Mining	Salt Lake	*95	*90	*95		
Keystone Mining	Salt Lake	*30	*30	*30	Fe., 1926	0.07½
Lucky Jim	Spokane	*25	*25	*25		
Lucky Tiger-Com.	Kansas City	†6.85	†6.65	...	Se. 6, Se. 20 M	0.05
Mammoth Mining	Salt Lake	1.60	1.60	1.60	De., 1926	0.25
North Lily	Salt Lake	7.95	7.85	7.90		
Park Utah	New York	11⅞	10⅜	11	Se., 11, Oc.1 Q	0.20
Plutus Mining	Salt Lake	1.85	1.85	1.85	Ap.10, Ap.16 Q	0.10
Rico-Argentine	Salt Lake	*53	*48	*53	June 15 Q	0.03
Sherman Lead	Spokane	*25	*21	*22½		
Silver King Coal	Salt Lake	13.37½	13.00	13.37½	Se.20, Oc.1 Q	0.25
Silversmith	Spokane	*14	*11	*12½	Oct., 1926 Q	0.02
Strattons Mines	Spokane	1.40	1.25	1.25		
Sunshine M. Co.	Spokane	1.48	1.35	1.45	June 20, K	0.02
Tamarack-Custer	Spokane	*45	*38½	*44½	Sept., 1924	0.25
Tintic Standard	Salt Lake	14.25	14.00	14.00	Se.19, Se.29 QX	0.30
Utah-Apex	Boston	4⅞	4½	4½	Jl.14, Au.1 K	0.25
IRON						
Bethlehem Steel	New York	66½	62½	64⅞	Jl., 1924	1.25
Cleveland-Cliffs Iron.	Cleveland	1.47½	1.40	1.40	Jl.14, Jl.25. Q	1.00
Colorado F & I, pfd.	New York	74½	68⅞	70½	Au.10, Au.25 Q	2.00
Gt. North'n Iron Ore.	New York	99	9⅜	99	Ap. 9, Ap. 30 K	0.75
Inland Steel	New York	71½	68⅜	70	Au. 15, Se.1 Q	0.62½
Republic I. & S.	New York	87⅞	79½	82½	Au. 14, Se. 1 Q	1.00
Republic I. & S. pfd.	New York	109⅞	109	109	Se. 15, Oc. 1 Q	1.75
Sloss-Sheffield S. & I.	New York	124	118	118	Se.10, Se.20 Q	1.50
Sloss-Snef. S.&I. pfd.	New York	...	...	120	Se. 20, Oc. 1 Q	1.75
U. S. Steel	New York	161⅛	156⅜	159½	Au.30, Se.29 Q	1.75
U. S. Steel, pfd.	New York	142	141	141½	Au. 6, Au. 30 Q	1.75
Virginia I. C. & C.	New York	25½	25½	25½	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York	....	....	50	Je. 16, Jl. 2 SA	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol.	New York	24½	24½	24½	Ju.16, Ju.26 K	0.97
So. Am. G. & P.	N. Y. Curb	4⅜	3¾	3¾		
Alum. Co. of Amer.	N. Y. Curb	143½	140	140		
Alum. Co. of Amer. pf.	N. Y. Curb	107½	107	107	Se. 15, Oc. 1 Q	1.75
Vanadium Corp.	New York	85	76½	81	Au. 1, Au. 15 Q	0.75
Patino M. & E.	New York	37⅞	34½	36	April, 1928	4s.
ASBESTOS						
Asbestos Corp.	Montreal	27⅜	27	27⅛	Jan., 1926	1.50
Asbestos Corp. pfd.	Montreal	90	90	90	Jl.30, Jl.16 Q	1.75
SULPHUR						
Freeport Texas	New York	62	56½	58⅜	Oc.15, No.1 QX	1.25
Texas Gulf	New York	71⅜	69⅜	71	Se. 1⅓, Se 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	53⅜	50	51	Au. 21, Se 1 Q	0.75
Amer. Metal, pfd. 6%	New York	110	109½	110	Au.15, Se.1 Q	1.50
Amer. Sm. & Ref.	New York	254½	242⅛	245	Se.30, No.1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	136	136	136	No.2, De. 1 Q	1.75
Consol. M. & S.	Montreal	270	267	267	Je.30, Jl.16 SAX	6.25
Newmont Mining	N. Y. Curb	180½	170	173⅞	Se.28, Oc.15 Q	1.00
U. S. Sm. R. & M.	New York	54⅛	51⅝	52½	Oc.5, Oc. 15 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	54	53	53	Oc. 5, Oc. 15 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. A, Annual. SA, Semi-annually. M, Monthly. FW, four weeks. K, irregular. I, Initial. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED September 18, 1928

Name	High	Low	Last	Date	Amount	Last Div.
Alaska Mexican ($5)	35/6	35/—	35/—			
Alaska Treadwell ($25)	120/6	120/—	120/—	Nov., 1926	4 (d)	
Aramayo Mines (25 frs.)	57/6	56/3	57/6	Aug, 1928	5 p.c. (†)	
Burma Corpn. (10 rupees)	15/1½	14/6	14/10½	Aug., 1928	6 annas*	
Bwana M'Kubwa (5s)	8/3	7/7½	8/1½			
Camp Bird (2s)	4/6	4/—	4/3	April, 1928	16⅔ p.c.	
El Oro (£1)	4/9	4/4½	4/7½	Nov., 1924	2½ p.c.*	
Frontino & Bolivia (£1)	11/—	10/—	10/—	July 1928	3⅛ p.c.	
Mexican Corpn. (£1)	10/—	9/3	9/9			
Mexico Mines of El Oro (£1)	20/3	18/9	20/—	Dec., 1926	3⅛ p.c.*	
Mond Nickel	112/6	106/3	107/6	Aug., 1928	20 p.c.	
N'Changa Copper Mining	19/9	19/—	19/6			
Oroville Dredging (£1)	3/7½	3/3	3/7½	Dec., 1923	3⅛ p.c.	
Rhodesian Congo Border (£1)	31/10½	30/7½	31/3			
St. John del Rey (£1)	12/3	11/6	11/6	April, 1928	7½ p.c.	
San Francisco Mines (10s)	28/6	28/—	28/4½	July 1928	12½ p.c.	
Santa Gertrudis (£1)	14/6	13/10½	14/—	July 1928	7½ p.c.	
Selukwe (2s. 6d.)	10/7½	10/—	10/3	April, 1917	6⅔ p.c.	
S. Amer. Copper (2s.)	2/3	2/—	2/—	Nov., 1917	75 p.c.	
Tanganyika (£1)	65/—	61/6	62/6	July 1928	5 p.c.	
Union Miniere du Haut-Katanga (Brussels)	11,500	11,025	11,050	July, 1928	182.60 (b)	

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.